[2] # ISPM 15:2009 DRAFT REVISION OF ANNEX 1: APPROVED TREATMENTS ASSOCIATED WITH WOOD PACKAGING MATERIAL

[3]

Date of this document	2011-05-10
Document category	Revision of Annex 1 to ISPM 15:2009
Current document stage	SC 2011-05 revised and approved for MC
Origin	Work programme topic, added by CPM-1 (2006): Revision of ISPM 15 (Regulation of wood packaging material in international trade) (2006-011-02). Related work programme submissions: *Sulfuryl fluoride fumigation of wood packaging material* (2007-101) added by SC 2010-11; *Microwave irradiation of wood packaging material* (2007-114) added by SC 2010-11
Major stages	2003-03 ICPM-4 adopted ISPM 15:2002 and requested that methyl bromide was to be reviewed SC 2004-11 approved Specification 31 2005-02 TPFQ requested Annex 1 to ISPM 15 to be modified based on recommendation by IFQRG 2005-04 SC approved revised Annex 1 to ISPM 15 for MC under fast track process 2005-11 SC-7 recommended Annex 1 to ISPM 15 to go to the SC without modifications (no formal objections received) 2005-11 SC recommended Annex 1 to ISPM 15 to go to CPM. CPM-1 (2006) adopted modifications to Annex 1 to ISPM 15 with modifications but requested that CPM members submit technical data to further revise and added revision of ISPM 15:2002 to the work programme 2006-06 TPFQ revised ISPM 15 2007-07 TPFQ revised ISPM 15 2008-05 SC-7 (acting as SC) approved ISPM 15 for MC 2008-11 SC recommended ISPM 15 to go to CPM CPM-4 (2009) adopted ISPM 15:2009 but retained the following subtopics on the work programme 1) criteria for treatments, which needed further research and 2) further guidance on fumigation in Annex 1 2009-06 TPFQ revised Annex 1 to ISPM 15 2010-09 TPFQ revised Annex 1 to ISPM 15 considering dielectric heat and sulfuryl fluoride treatments 2011-05 SC approved revision of Annex 1 to ISPM 15 to go for MC
Notes	Formatted in template of 2011-02; edited 2011-02-27. Formatted for SC 2011-05 on 2011-03-01; copy edited after SC 2011-05 on 2011-05-07. Sent to translation 2011-05-17. Grey text is original paragraphs which have not been changed. Commenting is not open for paragraphs. Changes proposed for member consultation are marked with underline (additions) or strikethrough (deletions).

[4] This annex was adopted by the ~~Interim~~ Commission on Phytosanitary Measures in [Month Year].

The annex is a prescriptive part of ~~the standard~~ ISPM 15:2009.

[5] ## ANNEX 1: Approved treatments associated with wood packaging material

[6] ### Use of debarked wood

[7] Irrespective of the type of treatment applied, wood packaging material must be made of debarked wood. For this standard, any number of visually separate and clearly distinct small pieces of bark may remain if they are:

[8]
- less than 3 cm in width (regardless of the length) or
- greater than 3 cm in width, with the total surface area of an individual piece of bark less than 50 square cm.

[9] For methyl bromide treatment, the removal of bark must be carried out before treatment as~~because~~ the presence of bark on the wood may affect~~s the efficacy of the methyl bromide~~ treatment efficacy. For heat treatments, the removal of bark ~~can~~may be carried out before or after treatment.

[10] ### Heat treatments

[11] Various energy sources or processes may be suitable to achieve the required treatment parameters. For example, kiln-drying, heat-enabled chemical pressure impregnation, dielectric radiation (microwave, radio frequency etc.) or other treatments may all be considered heat treatments provided they meet the heat treatment parameters specified in this standard.

[12] NPPOs shall ensure that the treatment temperatures are monitored at a location likely to be the coldest to ensure that the target temperature is maintained for the duration of treatment. The coldest part of the wood may differ depending on the energy sources or processes applied. When using microwaves as a heating source, the coldest part of the wood is the surface.

[13] ### Heat treatment using a conventional steam or dry kiln heat chamber (treatment code for the mark: HT)

[14] When using conventional heat chamber technology, the basic requirement is to achieve~~Wood packaging material must be heated in accordance with a specific time-temperature schedule that achieves~~ a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core). ~~Various energy sources of processes may be suitable to achieve these parameters. For example, kiln drying, heat-enabled chemical pressure impregnation, microwave or other treatments may all be considered heat treatments provided that they meet the treatment parameters specified in this standard.~~

[15] This temperature can be measured by placing temperature sensors in the core of the wood. Alternatively, treatment schedules may be developed based on a series of test treatments during which the core temperature of the wood at various locations in the heat chamber has been

measured and correlated with chamber air temperature to prove that a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood is achieved. Treatment schedules should be specified or approved by the NPPO.

[16] When approving and auditing a heat treatment provider, the NPPO shall ensure that the following factors are appropriately addressed by those involved in treatment:

[17]
1. Heat chambers are sealed and well insulated, including insulation in the floor.
2. Heat chambers are designed in a manner that permits uniform flow of air around and through the wood stack. Wood to be treated is loaded in a manner that maximizes air flow around and through the wood stack.
3. Air deflectors in the chamber area and spacers between wooden units are used as required to maximize air flow.
4. Fans are used to circulate air during treatment.
5. The coldest location within the chamber is identified and temperature sensors placed at this location.
6. Where the treatment is determined based upon temperature sensors inserted into the wood, at least two temperature sensors are used. These temperature sensors should be suitable for measuring wood core temperatures. The use of multiple temperature sensors ensures that any failure of a temperature sensor is detected during the treatment process. The temperature sensors are inserted at least 30 cm from the end of a board and penetrate to the centre of wood, or in the centre of pallet blocks, to ensure that the temperature at the core is measured. The piece of wood with the largest dimensions should be used for this. Any holes drilled in the wood to place the temperature sensor are sealed to prevent interference in temperature measurement by entry of air at ambient temperature.
7. If the air flow in the chamber is routinely reversed during treatment, an increased number of temperature sensors are used to account for a change in the location of the coldest area.
8. Where treatment schedules are based on monitoring chamber air temperature and used for treatment of different wood types (e.g. specific species and sizes), these schedules should take into account the species and thickness of wood being treated. A minimum of two temperature sensors are used in chambers treating wood packaging according to treatment schedules.
9. Temperature sensors, including the measurement and recording equipment, are calibrated at a frequency specified by the NPPO.
10. Temperatures should be monitored and recorded during each treatment to ensure that the prescribed minimum temperature is maintained for the required period of time. If temperatures are not maintained, the treatment should be restarted or the treatment time extended and the temperatures raised to ensure that all wood has been treated to meet the requirements.
11. For purposes of auditing, records of heat treatments and calibration should be retained by treatment providers for a period of time specified by the NPPO.

[18] **Heat treatment using a dielectric heat chamber (treatment code for the mark: DH)**

[19] Dielectric heating is based on the alternating electrical field of the electromagnetic wave emitted by the dielectric radiation source (e.g. microwave or radio frequency). Chemical compounds with asymmetric charge distribution, so-called dipole characters (e.g. water), tend to orientate along this electrical field and oscillate with the electrical field (e.g. 2.45 MHz causes 2.45 million oscillations per second). The friction generated through this process converts electric

energy into heat energy.

[20] Where the application of heat treatment is undertaken using dielectric radiation (e.g. microwaves), wood packaging material composed of wood not exceeding 20 cm in cross-section when measured across the smallest dimension of the piece must be heated to achieve a minimum of 60 °C for 1 minute throughout the profile of the wood. Heating to the prescribed temperature must occur within 30 minutes from ambient temperature.

[21] Treatment schedules shall be specified or approved by the NPPO.

[22] When approving and auditing a heat treatment provider, the NPPO shall ensure that the following factors are appropriately addressed by those involved in the treatment:

[23]
1. Irrespective of whether dielectric heat treatment is conducted as a batch process or as a continuous (conveyor) process, if the operator is measuring the surface temperature to estimate compliance with the prescribed standard, the operator should have initially validated through testing that the internal wood temperatures meet or exceed 60 °C for 1 minute through the entire profile of the wood (including its surface). For measuring the surface temperature at least two temperature sensors should be used.
2. For wood exceeding 5 cm in thickness, dielectric heating at 2.45 GHz requires bidirectional application or multiple waveguides for the delivery of microwave energy to ensure uniformity of heating. For wood less than 5 cm in thickness, uniformity of heating for the chamber should be tested and equipment modified as needed to ensure uniform heating.
3. Temperature sensors including the measurement and recording equipment are calibrated at a frequency specified by the NPPO.
4. For purposes of auditing the treatment provider, records of heat treatments and calibration should be retained by treatment providers for a period of time specified by the NPPO.

[24] ## Methyl bromide treatment (treatment code for the mark: MB)

[25] Use of methyl bromide should be undertaken taking into account the IPPC~~CPM~~ Recommendation on the r~~R~~eplacement or reduction of the use of methyl bromide as a phytosanitary measure (CPM, 2008). NPPOs are encouraged to promote the use of alternative treatments approved in this standard[1].

[26] The wood packaging material must be fumigated with methyl bromide in accordance with a schedule that achieves the minimum concentration-time product[2] (CT) over 24 hours at the temperature and final residual concentration specified in Table 1. Slight increases in the treatment time (e.g. 1–2 hours) may be permitted to achieve the required CT if the minimum final concentration is not met. This CT must be achieved throughout the wood, including at its core, although the concentrations would be measured in the ambient atmosphere. The minimum temperature of the wood and its surrounding atmosphere must be not less than 10 °C and the minimum exposure time must be not less than 24 hours. Monitoring of gas concentrations must be carried out at a minimum at 2, 4 and 24 hours. (~~i~~In the case of longer exposure times and weaker concentrations, additional measurement of the gas concentrations should be recorded at the end of fumigation~~)~~.

[27] **Table 1:** Minimum CT over 24 hours for wood packaging material fumigated with methyl bromide

[28]

Temperature (°C)	CT (g·h/m^3) over	Minimum final concentration (g/m^3)

	24 h	after 24 h#
21 ºC or above	650	24
16 ºC or above	800	28
10 ºC or above	900	32

[29] # In circumstances when the final concentration is not achieved after 24 hours, a deviation in the concentration of ~5% is allowed provided additional treatment time is added to the end of the treatment to achieve the prescribed CT.

[30] One example of a schedule that may be used for achieving the specified requirements is shown in Table 2.

[31] **Table 2:** Example of a treatment schedule that achieves the minimum required CT for wood packaging material treated with methyl bromide (initial doses may need to be higher in conditions of high sorption or leakage)

[32]

Temperature (°C)	Dosage (g/m^3)	Minimum concentration (g/m^3) at:		
		2 h	4 h	24 h
21 ºC or above	48	36	31	24
16 ºC or above	56	42	36	28
10 ºC or above	64	48	42	32

[33] NPPOs shall ensure that the following factors are appropriately addressed by those involved in the application of methyl bromide treatment under this standard:

[34]
1. Fans are used as appropriate during the gas distribution phase of fumigation to ensure that equilibrium is reached and should be positioned to ensure that the fumigant is rapidly and effectively distributed throughout the fumigation enclosure (preferably within one hour of application).
2. Fumigation enclosures are not loaded beyond 80% of their volume.
3. Fumigation enclosures are well sealed and as gas tight as possible. If fumigation is to be carried out under sheets, these must be made of gas-proof material and sealed appropriately at seams and at floor level.
4. The fumigation site floor is either impermeable to the fumigant or gas-proof sheets must be laid on the floor.
5. Consideration should be given to the use of a vaporizer to apply methyl bromide ("hot gassing")~~Methyl bromide is often applied through a vaporizer ("hot gassing")~~ in order to fully volatilize the fumigant prior to its entry into the fumigation enclosure.
6. Methyl bromide treatment is not carried out on wood packaging material exceeding 20 cm in cross-section when measured across the smallest dimension of the piece. Therefore, ~~W~~wood stacks may need separators to ensure adequate methyl bromide circulation and penetration. Wood packaging containing a piece of wood exceeding 20 cm in cross-section when measured across the smallest dimension of the piece should not be treated with methyl bromide.
7. The concentration of methyl bromide is always measured at a location furthest from the insertion point of the gas as well as other locations, to confirm when gas equilibrium is reached.
8. When calculating methyl bromide dosage, compensation is made for any gas mixtures (e.g. 2% chloropicrin) to ensure that the total amount of methyl bromide applied meets required

dosage rates.

9. Initial dose rates and post-treatment product handling procedures take account of likely methyl bromide sorption by the treated wood packaging material or associated product (e.g. polystyrene boxes).
10. The measured temperature of the product or the ambient air (whichever is the lower) is used to calculate the methyl bromide dose, and must be at least 10 °C (including at the wood core) throughout the duration of the treatment.
11. Wood packaging material to be fumigated is not wrapped or coated in materials impervious to the fumigant.
12. The equipment used to measure gas concentrations and temperature (where used) is calibrated at a frequency specified by the NPPO.
13. Records of methyl bromide treatments and calibration are retained by treatment providers, for a period of time determined ~~and as required~~by the NPPO, for auditing purposes.

[35] NPPOs should recommend that measures be taken to reduce or eliminate emissions of methyl bromide to the atmosphere where technically and economically feasible (as described in the IPPC~~CPM~~ Recommendation on the r~~R~~eplacement or reduction of the use of methyl bromide as a phytosanitary measure (CPM, 2008)).

[36] **Adoption of alternative treatments and revisions of approved treatment schedules**

[37] As new technical information becomes available, existing treatments may be reviewed and modified, and alternative treatments and/or new treatment schedule(s) for wood packaging material may be adopted by the CPM~~Commission on Phytosanitary Measures~~. If a new treatment or a revised treatment schedule is adopted for wood packaging material and incorporated into this ISPM, material treated under the previous treatment and/or schedule does not need to be re-treated or re-marked.

[38] [1] In addition, contracting parties to the IPPC may also have obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer (UNEP, 2000).

[39] [2] The CT product utilized for methyl bromide treatment in this standard is the sum of the product of the concentration (g/m^3) and time (h) over the duration of the treatment.

[2] This phytosanitary treatment was adopted by the Commission on Phytosanitary Measures in --- 201-.

The annex is a prescriptive part of ISPM 28:2007.

[3] # ISPM 28:2007 ANNEX X: HEAT TREATMENT OF WOOD PACKAGING MATERIAL USING DIELECTRIC HEAT (20--)

[4] ## Publication history

[5]

Date of this document	2011-05-16
Document category	Draft new Annex XX to ISPM 28:2007
Current document stage	Approved to go for MC 2011-06
Origin	CPM-1 (2006) added topic 2006-011 Revision of ISPM 15 (Regulation of wood packaging material in international trade) SC 2010-11 added topic 2007-114 Microwave irradiation of wood packaging material
Major stages	2006-12 treatment submitted to TPPT meeting 2007-07 revised text considered by TPFQ 2007-12 further revised text submitted to TPPT 2009-07 amended text considered by TPFQ, July 2009 2009-10 additional information submitted to TPPT, October 2009 2010-07 text updated July 2010 2011-03-29 text submitted to SC e-discussion forum and revised based on SC comments Text submitted to SC e-discussion poll SC 2011-05 approved to go for MC
Notes	2011-05 formatted and revised according to changes made to draft annex 1 to ISPM 15:2009

[6] ## Scope of the treatment

[7] This treatment applies to the heat treatment of wood packaging material using dielectric heat to reduce the risk of introduction and spread of Asian longhorned beetle (*Anoplophora glabripennis*) (ALB), pinewood nematode (*Bursaphelenchus xylophilus*) (PWN)[1] and those pests required to meet the criteria for treatment as prescribed in ISPM 15.

[8] ## Treatment description

[9] **Name of treatment** Heat treatment of wood packaging material using dielectric heat

[10] **Active ingredient** N/A

[11] **Treatment type** Heat

[12] **Target pest** Asian longhorned beetle (*Anoplophora glabripennis*) (ALB) and pinewood nematode (*Bursaphelenchus xylophilus*) (PWN).

[13] **Target regulated articles** Debarked wood not exceeding 20 cm in cross-section

[14] **Treatment schedule**

[15] Where the application of heat treatment is undertaken using dielectric radiation (e.g. microwaves), wood packaging material composed of wood not exceeding 20 cm in cross-section when measured across the smallest dimension of the piece must be heated to achieve a minimum of 60 ˚C for 1 minute throughout the profile of the wood. Heating to the prescribed temperature must occur within 30 minutes from ambient temperature.

[16] Efficacy and confidence level of the treatment to kill the larvae and pupae of *Anoplophora glabripennis* and all life stages of *Bursaphelenchus xylophilus* are greater than $ED_{99.99683}$ at the 95% confidence level.

[17] When approving and auditing a heat treatment provider, the National Plant Protection Organization (NPPO) shall ensure that the following factors are appropriately addressed by those involved in treatment:

[18]
- The treatment needs to be monitored where the temperature is likely to be the coldest to ensure the target temperature is maintained.
- Irrespective of whether the dielectric heat treatment is conducted as a batch process or as a continuous (conveyor) process, if the operator is measuring the surface temperature to estimate compliance with the prescribed standard, the operator should have initially validated through testing that the internal wood temperatures meet or exceed 60 ˚C for 1 minute through the profile of the wood. For measuring the surface temperature at least two temperature sensors should be used.
- For wood exceeding 5 cm in thickness, dielectric heating at 2.45 GHz may require bidirectional application or multiple waveguides for the delivery of microwave energy to ensure uniformity of heating. For wood less than 5 cm in thickness, uniformity of heating for the chamber should be tested and equipment modified as needed to ensure uniform heating.
- Temperature sensors including the measurement and recording equipment are calibrated at a frequency specified by the NPPO.

[19] **Other relevant information**

[20] The coldest part of the wood will differ depending on the energy sources or processes applied. When using microwaves as a heating source, the coldest part of the wood is the surface.

[21] The TPPT based its evaluation of this treatment for ALB and PWN on the research work reported respectively by Fleming *et al.*, 2003, and Hoover *et al.*, 2010.

[22] The general effectiveness of this treatment against other pests was supported by Fleming *et al.*, 2004; Henin et al., 2008; Soma *et al.*, 2002, 2003; Tomminen, J., Halik, S. and Bergdahl, D.R. ,1991 and Tomminen, J. and Nuorteva, M., 1992.

[23] **References**

Dubois, T., Hajek, A.E. & Smith, S. 2002. Methods for rearing the Asian longhorned beetle (Coleoptera: Cerambycidae) on artificial diet. Annals of the Entomological Society of America, 95: 223–230.

Fleming, M., Hoover, K., Janowiak, J., Fang, Y., Wang, X., Liu, W., Wang, Y., Hang, X., Agrawal, D., Mastro, V. & Roy, R. 2003. Microwave irradiation of solid wood packing material (pallet and crate lumber): An effective technique to destroy the Asian longhorned beetle (*Anoplophora glabripennis*) hitchhiking to the United States. Forest Products Journal, 52: 1–7.

Fleming, M.R., Janowiak, J.J., Kearns, J., Shield, J.E., Roy, R., Agrawal, D.K., Bauer, L.S., Miller, D.L. & Hoover, K. 2004. Parameters for scale-up of microwave treatment to eradicate cerambycid larvae infesting solid wood packing materials. Forest Products Journal, 54 (7/8): 80–84.

Henin, J.-M., Charron, S., Luypaert, P.J., Jourez, B. & Hebert, J. 2008. Strategy to control the effectiveness of microwave treatment of wood in the framework of the implementation of ISPM 15. Forest Products Journal, 58: 75–81.

Hoover, K., Uzunovic, A., Gething, B., Dale, A., Leung, K., Ostiguy, N. & Janowiak, J.J. 2010. Lethal temperature for pinewood nematode, *Bursaphelenchus xylophilus*, in infested wood using microwave energy. In press.

Soma, Y., H. Naito, H., Misumi, T., Tsuchiya, Y., Mizobuchi, M., Matsuoka, I., Kawakami, F., Hirata, K. & Komatsu, H. 2002. Effects of some fumigants on pine wood nematode, *Bursaphelenchus xylophilus* infecting wooden packages. 2. Mortality of pine wood nematode by methyl bromide tent fumigation. Research Bulletin of the Plant Protection Service Japan, 38: 13–19.

Soma, Y., Goto, M., Naito, H., Ogawa, N., Kawakami, F., Hirata, K., Komatsu, H. & Matsumoto, Y. 2003. Effects of some fumigants on mortality of pine wood nematode, *Bursaphelenchus xylophilus* infecting wooden packages. 3. Mortality and fumigation standards for pine wood nematode by methyl bromide. Research Bulletin of the Plant Protection Service Japan, 39: 7–14.

Stamps, W.T. & Linit, M.J. 1995. A rapid and simple method for staining lipid in fixed nematodes. Journal of Nematology, 27: 244–247.

Tomminen, J., Halik, S. & Bergdahl, D.R. 1991. Incubation temperature and time effects on life stages of *Bursaphelenchus-xylophilus* in wood chips. Journal of Nematology, 23: 477–484.

Tomminen, J. & Nuorteva, M. 1992. Pinewood nematode, *Bursaphelenchus xylophilus* in commercial sawn wood and its control by kiln-heating. Scandinavian *Journal of Forest Research* 7: 113–120.

[24] [1] The scope of phytosanitary treatments does not include issues related to pesticide registration or other domestic requirements for approval of treatments. Treatments also do not provide information on specific effects on human health or food safety, which should be addressed using domestic procedures prior to approval of a treatment. In addition, potential effects of treatments on product quality are considered for some host commodities before their international adoption. However, evaluation of any effects of a treatment on the quality of commodities may require additional consideration. There is no obligation for a contracting party to approve, register or adopt the treatments for use in its territory.

[2] This phytosanitary treatment was adopted by the Commission on Phytosanitary Measures in --- 201-.

The annex is a prescriptive part of ISPM 28:2007.

[3]

ISPM 28:2007 ANNEX X: VAPOUR HEAT TREATMENT OF *CUCUMIS MELO* VAR. *RETICULATUS* FOR *BACTROCERA CUCURBITAE* (201)

[4] **Publication information**

[5]

Date of this document	2011-05-16
Document category	Draft new Annex XX to ISPM 28:2007
Current document stage	2011-06 Member consultation
Origin	CPM-2 (2007) added topic 2006-TPPT-110 Fruit fly treatments
Major stages	Treatment submitted to TPPT in 2006 Text updated July 2010 Approved by SC E-decision 2011-05 to go for MC
Notes	2011-04 formatted in template. 2011-05-16 formatted for MC.

[6] **Scope of the treatment**

[7] This treatment applies to the vapour heat treatment of *Cucumis melo* var. *reticulatus* (netted melon) fruit to result in the mortality of eggs and larvae of *Bactrocera cucurbitae* (melon fly) at the stated efficacy level[1].

[8] **Treatment description**

[9] **Name of treatment** Vapour heat treatment of *Cucumis melo* var. *reticulatus* fruit for *Bactrocera cucurbitae*

[10] **Active ingredient** N/A

[11] **Treatment type** Vapour heat

[12] **Target pest** *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae)

[13] **Target regulated articles** Fruit of *Cucumis melo* var. *reticulatus* (Netted melon)

[14] **Treatment schedule**

[15] This schedule requires a pre-heating time of between 3 to 5 hours using saturated water vapour (of greater than 90% RH) at 46 °C to allow the core of the melons to reach the target temperature of 45 °C.

[16] Once the core temperature of the fruit reaches 45 °C, expose the melons at 46 °C using saturated water vapour (of greater than 90% RH) for 30 minutes.

[17] This treatment should be followed by cooling at ambient air temperatures.

[18] Efficacy and confidence level of the treatment is $ED_{99.9922}$ at the 95% confidence level.

[19] The commodity temperature and relative humidity should be monitored during treatment and should not fall below the stated level.

[20] **Other relevant information**

[21] Following treatment, fruit was not artificially cooled.

[22] In evaluating this treatment, the TPPT considered issues associated with treatments based on temperature, taking into account the work of Hallman and Mangan (1997).

[23] This schedule was based on the work of Iwata *et al*., 1990.

[24] This schedule was developed using cultivar "Earl's Favourite".

[25] **References**

Hallman, G.J. & Mangan, R.L. 1997. Concerns with temperature quarantine treatment research. *In* Proceedings of the 1997 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reduction, San Diego, California, USA. Available at http://www.mbao.org/mbrpro97.html (accessed September 2010).

Iwata, M., Sunagawa, K., Kume, K. & Ishikawa, A. 1990. Efficacy of vapour heat treatment on netted melon infested with melon fly, Dacus cucurbitae, Coquillett (*Diptera: Tephritidae*). Research Bulletin of the Plant Protection Service, Japan, 26:45–49.

[26] [1] The scope of phytosanitary treatments does not include issues related to pesticide registration or other domestic requirements for approval of treatments. Treatments also do not provide information on specific effects on human health or food safety, which should be addressed using domestic procedures prior to approval of a treatment. In addition, potential effects of treatments on product quality are considered for some host commodities before their international adoption. However, evaluation of any effects of a treatment on the quality of commodities may require additional consideration. There is no obligation for a contracting party to approve, register or adopt the treatments for use in its territory.

This document contains two parts:

Part 1: Proposed draft Annex 4 (*Pest risk analysis for plants as quarantine pests*) to ISPM 11:2004

Part 2: Proposed consequential changes to ISPM 11:2004, *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms*

[1]

PART 1: PROPOSED DRAFT ANNEX 4 TO ISPM 11:2004
PEST RISK ANALYSIS FOR PLANTS AS QUARANTINE PESTS

Note: Part 1 of the current document results in a need to make consequential changes to ISPM 11:2004 which are proposed in Part 2. In Part 1, all references to annexes or appendixes refer to ISPM 11:2004, Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms *(unless otherwise indicated).*

[2]

Date of this document	2011-05-12
Document category	Draft Annex 4 to ISPM 11:2004
Current document stage	SC 2011-05 approved for member consultation
Origin	ICPM-7 (2005) added work programme topic 2005-001: Pest risk analysis for plants as quarantine pests
Major stages	Specification No. 44 rev. 1, approved SC 2007-05; EWG 2009-05 drafted revision; revised SC 2009-05 and SC 2010-04; Steward revised ISPM based on comments. SC 2011-05 approved for MC
Notes	2011-01-31: Document formatted for editor. 2011-02-08: edited. 2011-03-02: Formatted for SC 2011-05. Draft revised by SC 2011-05. 2011-05-11: Formatted for editor and OCS; editorial check 2011-05-12.

[3]

This annex was adopted by the [Xth] Commission on Phytosanitary Measures in [Month Year].

The annex is a prescriptive part of the standard.

[4]

ANNEX 4: Pest risk analysis for plants as quarantine pests

[5]

Introduction

[6] This annex provides guidance for conducting pest risk analysis (PRA) to determine if a plant is a pest of cultivated plants or wild flora, whether it should be regulated, and to identify appropriate phytosanitary measures. It focuses primarily on plants proposed for import and does not cover the unintentional introduction of plants as contaminants in commodities or conveyances.

[7] The number and diversity of plants being moved between and in countries is increasing as opportunities for trade increase and markets develop for new plants. The risk of introducing new pests with plants as a pathway has long been recognized and widely regulated. However, pest risk posed by the plant species themselves or pest risk for plants in natural and semi-natural habitats requires specific consideration.

[8] *Plants as pests*

[9] Plants as pests may affect other plants through competition for limited resources, such as space, light, nutrients and water, or through parasitism or allelopathy. Plants new to an area may also

become pests by hybridizing with cultivated plants or plants in the wild flora.

[10] Thus, the protection of plants as pursued through the IPPC may include considering certain plant species as pests, and taking measures to prevent their introduction and spread. Determining which species should be deemed pests is context-specific and may vary with geography, habitat, land use, time and the perceived value of the natural resources in the endangered area. PRA should form the basis of such determination and subsequent decisions regarding possible regulation of the plant species. It should be noted that plants having undergone such analysis may also require analysis of their potential to be pathways for other pests.

[11] The IPPC has recognized the importance of plants as pests by underscoring that the definition of "pest" includes weeds (ICPM, 2001), and by specifically including "plants that are invasive alien species" in a range of recommendations for action for those invasive alien species that are pests of plants (ICPM, 2005).

[12] The IPPC is concerned with pests injurious to cultivated as well as wild plants (see Annex 1 of this standard), and therefore weeds and invasive alien plants that are injurious to other plants should be considered pests in the IPPC context. Henceforth in this annex, the terms "weed" and "invasive alien plants" are not used, but only the single term "plants as pests"[1].

[13] The remainder of the text generally follows the sequence of ISPM 11:2004 with the corresponding sections of the standard indicated in parentheses. In each section, guidance is provided regarding analytical aspects particular to plants as pests.

[14] **Stage 1: Initiation**

[15] *Pre-selection*

[16] ISPM 2:2007 describes, as part of the initiation stage, a pre-selection step intended for determining whether or not an organism is a pest, and provides some indicators that a plant may be a pest. Particular attention is needed for plants that have proven to be pests elsewhere or having intrinsic traits such as strong competition or propagule dispersal abilities. In most cases, consideration of these factors in Stage 1 of PRA may not be sufficient to terminate the process; however, in cases where the plant is clearly only suited to a specific type of habitat that does not exist in the PRA area, it may be concluded that the plant cannot become a pest in that area and the PRA process may stop at that point.

[17] **Stage 2: Pest risk assessment**

[18] *Identity of the plant* (refer to section 2.1.1)

[19] The taxonomic level considered in PRA is usually the species. However, in the case of cultivated plants, higher or lower taxonomic levels may be used. The taxonomic level appropriate for conducting the PRA for a particular plant as pest should be determined by the NPPO.

[20] Some particular considerations regarding plants as pests may include the following:

[21] - The taxonomic identity of the plant may be unclear because it has been obscured by breeding or hybridization. This is particularly relevant for plants in the horticultural trade. The NPPO should acquire the best possible information about the identity and parentage of the plant from various sources (e.g. the prospective importer, plant breeders, scientific literature).

- The use of taxonomic levels below the species (i.e. subspecies, variety, cultivar) may be justified if there is evidence demonstrating that differences in traits are stable and significantly affect phytosanitary status. Examples may include differences in adaptability to environmental conditions, ability to exploit resources, ability to defend against herbivory or grazing/browsing, and methods of reproduction or propagule dispersal.

The evaluation of a hybrid should be based on information specific to that taxon where available. In the absence of such information, PRA may be conducted on the parent species to determine their pest risk. If either parent is determined to be a pest and the associated risk is deemed unacceptable, this information may form the basis of regulatory decisions.

[22] *Presence or absence in PRA area* (refer to section 2.1.1.2)

[23] Determination of presence or absence in the PRA area is a particular challenge for NPPOs when plants are proposed for import because the plants may already be present in locations (e.g. botanical gardens, home gardens) that are not reported in the scientific literature. Additional sources of information to be consulted may include horticultural, agricultural, forestry and aquaculture publications.

[24] *Intended use*

[25] The PRA should be conducted considering the intended use of the plants as this may affect the probability of establishment, spread and economic consequences. However, it should also be recognized that plants, once entered, may escape or be diverted from the use for which they were originally intended.

[26] Plants for planting are generally considered of the highest risk. Examples of uses, broadly in the order of decreasing risk, are:

[27] - planting in the open landscape without further management (e.g. for soil erosion control, waste water treatment, aquatic plants in ponds)

- planting in the open landscape with management (e.g. in forestry, agriculture including for biofuel, horticulture)

- planting outdoors in urban areas (e.g. for amenity purposes in roadsides, parks and gardens)

planting indoors only.

[28] Other intended uses may be considered, including human consumption or animal feed, processing or combustion for energy production. For example, spillage of grain intended for processing may lead to unintended growth of plants as pests.

[29] *Habitats and intended locations*

[30] Plants imported for planting may be destined for a particular planting location (which may be termed as the "intended location"). However, the probability that the plants may spread to and establish in other unintended locations in the PRA area of the same or another habitat type should be assessed. The assessment should consider the suitability of all habitat types in the entire PRA area, and the extent of suitable habitats be determined in order to identify the endangered area.

[31] The analysis of suitable habitats is analogous to the analysis of host plants (in the rare case of parasite plants, both host and habitat need to be considered). The guidance provided in section

2.2.2 (and its subsections) of this standard can generally be used, substituting the term "host" or "host range" for "suitable habitat".

[32] If the plant already occurs in parts of the PRA area, the locations and types of habitats where it occurs should be described, noting whether the locations are intended or unintended.

[33] *Probability of entry* (refer to section 2.2.1)

[34] For imported plants, the probability of entry need not be assessed. However, to assess the likelihood of unintended establishment and spread and to identify possible risk management options, an estimation of the volume, frequency and destinations of prospective imports may be needed.

[35] *Historical evidence of pest behaviour*

[36] The most reliable predictor of establishment, spread and potential economic consequence is the history of pest behaviour in other areas with similar habitats. Where a history of pest behaviour is documented the assessment should use this information, noting whether the habitat and climate conditions are sufficiently similar in the PRA area. However, a plant may never have been moved out of its native range where it may be controlled by naturally occurring pests. In such cases, no historical evidence exists of establishment, spread or consequences.

[37] *Probability of establishment* (refer to section 2.2.2)

[38] In all cases, the assessment of the probability of establishment, should, as for other pests, consider the suitability of the climate, other abiotic and biotic factors (see section 2.2.2.2) and cultural practices (see section 2.2.2.3) in habitats within the PRA area based on habitats in which the plant currently occurs. Subject to information availability, the following may be incorporated:

[39]
- *climate:* suitability of current and future projected climates
- *other abiotic factors:* soil characteristics, topography, hydrology, fire regime etc.
- *biotic factors:* current vegetation, degree of disturbance, presence or absence of natural enemies and competitors

cultural practices in crops/managed plant communities: herbicide usage, harvesting, soil cultivation, fire etc., including side-effects such as aerial deposition of nitrogen or pesticides.

[40] The assessment should also consider intrinsic traits of the plant that may predict establishment and spread (refer to section 2.2.2.4). This is particularly important where history of pest behaviour is not well documented. Traits to be considered may include:

[41]
- *reproductive traits:* sexual and asexual mechanisms, dioecism, self-compatibility, reproduction frequency, generation time
- *adaptive potential (of individuals and populations):* genotypic or phenotypic plasticity, hybridization potential
- *propagule attributes:* volume and viability, dormancy

tolerance/resistance: response to herbicides, grazing and other actual cultural practices, drought, salinity.

[42] Many plants as pests are opportunists with a strong potential to become established in disturbed habitats. Plants with a robust dormancy combined with a prolific reproductive ability are particularly suited for such opportunistic strategy. Disturbed habitats are common; therefore plants with such adaptations will encounter relatively more opportunities for establishment and spread.

[43] *Probability of spread* (refer to section 2.2.3)

[44] The likelihood and extent of spread from intended to unintended locations depends on natural

and human-mediated factors. These factors include:

[45] - intrinsic traits of the plant species (in particular regarding reproduction, adaptation and propagule dispersal)

- existence of natural vectors (birds and other animals, water)

existence and spatial pattern of suitable habitats and dispersal corridors connecting them.

[46] Human-mediated factors may be intentional or unintentional. The probability of intentional spread by human agency depends mainly on:

[47] - intended use of the plants

- desirability and economic value of the plants

- ease of transport of the plants

public awareness about the risk associated with plants as pests.

[48] The probability of unintentional spread by human agency depends mainly on:

[49] - probability that propagules will adhere to clothing, vehicles, machinery, tools, equipment

probability that propagules will be a contaminant of other products or material.

[50] There are often long time lags between an initial plant introduction and its later spread. As a consequence, even in the cases where establishment may be well documented, the potential for later spread may be less known. Possible reasons for the time lag include:

[51] - changes in climate (such as warmer climate or changes in precipitation patterns)

- changes in other abiotic factors (e.g. an increase in aerial deposition of nitrogen or sulphur)

- changes in the genetic profile of the plant species (through natural selection, genetic drift etc.)

- emergence of novel uses for the plant

- relatively rare dispersal events that move propagules from suboptimal to optimal habitats

changes in land use or disturbance pattern.

[52] *Assessment of potential economic consequences* (refer section 2.3)

[53] Plants as pests, like other pests, can have a variety of direct and indirect economic consequences, including environmental consequences. These may include yield losses or reduction of biodiversity and effects on other ecosystem components. Plants as pests may have broad agricultural, environmental and social consequences that may be non-specific and not readily apparent (e.g. changes of nutrient concentration in the soil). For this reason, evaluation of consequences of plants as pests may be inherently difficult because it requires consideration of consequences that are not easily quantified. It is important to consider the long-term consequences for all locations in the PRA area, including where the plants were intentionally planted.

[54] As for establishment and spread, the most reliable predictor of potential consequences is evidence of consequences elsewhere, particularly in areas with similar habitats. However, in some cases, plants have never been moved out of their native ranges and therefore not had an opportunity to express any potential consequences. In the absence of evidence of consequences elsewhere, consideration may be given to whether or not the plant possesses intrinsic traits that predict pest potential, such as those discussed above and in section 2.2.2.4 related to establishment and spread.

[55] As for any type of organism, if the risk assessment determines the plant species represents an unacceptable risk, the PRA may continue with the analysis of risk management (Stage 3).

[56] **Stage 3: Pest risk management (refer to section 3.4)**

[57] Plants for planting will usually be introduced into environments suitable for their growth and establishment. In such cases, most risk management options would be counterproductive to the intended use. In general, for plants for planting that have the characteristics of quarantine pests, the most effective risk management option may be prohibition (refer to section 3.4.6). However, those plants as a commodity may at the same time have a perceived benefit that may be considered in the decision process following the PRA.

[58] For specific situations, other pest risk management options may be pursued, including:

[59]
- requirements for growing of plants under confinement
- requirements for harvesting of plants at a certain stage or specified time to prevent opportunities for reproduction
- restriction of plants to particular localities, such as those that are marginally suitable
- restrictions on the disposal of excess or waste plant material
- other restrictions on sale, holding, transport or planting

codes of conduct for sale, holding, transport or planting, e.g. in the form of internal rules within the plant industry to refrain from or restrict the selling of particular plants.

[60] For plants imported for consumption or processing, risk management options may include restrictions on transport, storage, locations, sale, seasonality and requirements regarding the processing or treatments.

[61] In identifying risk management options, the suitability of control measures, ease of access to the plants, time needed for effective control and difficulty of containment should be considered. For example, plants in highly managed systems such as cropping systems are more easily controlled than plants in natural or semi-natural habitats, or in private gardens. Many of the factors considered under "establishment" and "spread" also influence a plant's response to control measures and thus the feasibility of control.

[62] Irrespective of risk management options, where the import of a plant is allowed, it may be appropriate to develop post-import systems such as surveillance in the PRA area, contingency plans and systems to report new occurrences.

[63] **Aspects common to all PRA stages**

[64] *Risk communication* (refer to ISPM 2:2007)

[65] Plants intentionally introduced for planting may not be perceived as a threat by the public, or by particular stakeholders, who may perceive plants as purely beneficial. Furthermore, in some countries differing legislation or authorities may be involved in regulating various plants as pests. Therefore, risk communication may be particularly important in relation to plants as pests.

[66] Risk communication may include for example:

[67]
- consultation with importers and other governmental and non-governmental organizations (e.g. environmental protection agencies, parks departments, nurseries, landscapers) to exchange information on plants as potential pests
- publication of lists of plants as regulated pests

labelling of plants in commerce, e.g. explaining the pest risk the plants may pose and under which conditions the pest risk may occur.

[1] # PART 2: PROPOSED CONSEQUENTIAL CHANGES TO ISPM 11:2004

In Part 2, all references refer to ISPM 11:2004 (unless otherwise indicated) and references to Annex 4 refer to Part 1 (proposed Annex 4).

[2]

Date of this document	2011-05-12
Document category	Revision of ISPM 11:2004 (consequential changes)
Current document stage	Draft revised by SC 2011-05
Origin	
Major stages	SC 2011-05 SC revised text (consequential changes due to the proposed Annex 4) and approved for member consultation 2011.
Notes	Formatted for OCS 2011-05-11; editorial check 2011-05-12

[3] ## ISPM 11: Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms

[4] ### 1. *In* ENDORSEMENT, add at the bottom as new paragraph:

[5] Annex 4 on pest risk analysis for plants as quarantine pests, together with associated changes in the core text of the standard, was adopted by the [Xth] Commission on Phytosanitary Measures in [Month, Year].

[6] ### 2. *In* SCOPE, add at the bottom as new paragraph:

[7] More detailed guidance on PRA for plants as pests is provided in Annex 4.

[8] ### 3. *IN* REFERENCES, add following references:

[9] **ISPM 2.** 2007. Framework for pest risk analysis. Rome, IPPC, FAO.

[10] **ICPM.** 2001. Report of the Third Interim Commission on Phytosanitary Measures, Rome, 2-6 April 2001. Rome, IPPC, FAO.

[11] **ICPM.** 2005. Report of the Seventh Interim commission on Phytosanitary Measures, Rome 4-7 April 2005. Rome, IPPC, FAO.

[12] ### 4. *In* Section 1.4 Conclusion of initiation, *add at the bottom as new paragraph*:

[13] More detailed guidance on PRA for plants as pests is provided in Annex 4.

[14] ### 5. *In* Section 1.1 Initiation points, paragraph 2, sentence 5, *modify as follows*:

[15] In addition, many organisms indirectly affecting plants also satisfy this definition (such as ~~weeds/invasive~~ plants as pests, e.g. weeds, invasive alien plants).

[16] **6. *In* Section 2 Stage 2: Pest Risk Assessment, *add at the bottom as new paragraph:***

[17] More detailed guidance on pre-selection of plants as pests is provided in Annex 4.

[18] **7. *In* Section 2.1.1.1 Identity of pest, after paragraph 2, *add as new paragraph:***

[19] More detailed guidance on the consideration of identity of plants as pests is provided in Annex 4.

[20] ***8.* *In* Section 2.1.1.2 Presence or absence in PRA area, after paragraph 1, *add as new paragraph:***

[21] More detailed guidance on the consideration of presence or absence of plants as pests is provided in Annex 4.

[22] **9. *In* Section 2.2 Assessment of the probability of introduction and spread, paragraphs 4–7, *modify as follows:***

[23] *S1* With respect to a plant being assessed as a pest with indirect effects, wherever a reference is made to a host or a host range, this should be understood to refer instead to a suitable habitat[2] ~~(that is a place where the plant can grow)~~ in the PRA area.

~~[24] *S1* The intended habitat is the place where the plants are intended to grow and the unintended habitat is the place where the plants are not intended to grow.~~

[25] *S1* In the case of plants as pests~~to be imported~~, the concepts of entry, establishment and spread may have to be considered differently.

[26] *S1* For p~~P~~lants for planting ~~that are~~ proposed for import~~ed will enter and then~~, the probability of entry need not be assessed. Following import, the plants may be planted and maintained in an intended~~habitat~~ location, probably in substantial numbers and for an indeterminate period. ~~Accordingly, Section 2.2.1 on Entry does not apply.~~ The risk arises because of the ~~probability~~ possibility that the plant may spread from the intended ~~habitat~~ location to unintended ~~habitats~~ locations~~within the PRA area~~, and then establish ~~in those habitats~~there. Accordingly, section 2.2.3 may be considered before section 2.2.2. ~~Unintended habitats may occur in the vicinity of the intended habitat in the PRA area.~~

[27] *S1* Imported plants not intended to be planted may be used for different purposes (e.g. used as bird seed, as fodder, or for processing). The pest risk of plants as pests proposed for import for intended uses other than planting arises because of the probability that the plants may escape or be diverted from the intended use to an unintended location ~~habitat~~ and establish there.

[2] In the case of organisms that affect plants indirectly, through effects on other organisms, the terms host/habitat will extend also to those other organisms.

[28] More detailed guidance on the consideration of habitats and unintended locations for plants as pests is provided in Annex 4.

[29] **10. *In* Section 2.2.1 Probability of entry of a pest, paragraph 3, *modify as follows*:**

[30] *S1* The probability of entry need not be assessed for plants that are proposed for import. ~~In the case of plants to be imported, the plants will enter and an assessment of probability of entry will not be required. Therefore this section does not apply~~However, the probability of entry needs to be assessed for ~~this section does apply to~~ pests that may be carried by such plants (e.g. contaminating ~~weed~~ seeds carried with seeds imported for planting).

[31] More detailed guidance on the probability of entry for plants as pests is provided in Annex 4.

[32] **11. *In* Section 2.2.2 Probability of establishment, paragraph 3, *modify as follows:***

[33] *S1* In the case of plants~~to be imported~~ as pests, the assessment of the probability of establishment concerns the establishment in unintended locations~~unintended habitats~~.

[34] More detailed guidance on the probability of establishment, including considerations on the intended use, of plants as pests is provided in Annex 4.

[35] **12. *In* Section 2.2.3 Probability of spread after establishment, paragraph 2, *modify as follows*:**

[36] *S1* In the case of plants ~~to be imported~~as pests, the assessment of spread concerns spread from the intended location ~~habitat~~ or the intended use to ~~an~~ unintended locations~~habitat,~~ where the plant ~~pest~~ may establish. Further spread may then occur to other unintended ~~habitats~~ locations.

[37] More detailed guidance on probability of spread after establishment, including considerations on the intended use, of plants as pests is provided in Annex 4.

[38] **13. *In* Section 2.3 Assessment of potential economic consequences, after paragraph 2 *add as new paragraph*:**

[39] More detailed guidance on potential economic impact of plants as pests is provided in Annex 4.

[40] **14. *In* Section 2.3.1 Pest effects, paragraph 2, *modify as follows*:**

[41] *S1* The basic method for estimating the potential economic importance of pests in this section also applies to:

[42] - pests affecting uncultivated/unmanaged plants

[43] - ~~weeds and/or invasive~~ plants as pests ~~and~~

[44] pests affecting plants through effects on other organisms.

[45] **15. *In* Section 2.3.1 Pest effects, paragraph 4, modify as follows:**

[46] *S1* In the case of plants for planting ~~to be imported for planting~~that may be pests, the long-term consequences even for the intended location ~~habitat~~ may be included in the assessment. Planting may affect further use or have a harmful effect on ~~the intended~~ that ~~habitat~~location.

[47] **16. *In* Section 2.3.1 Pest effects, paragraph 5, sentence 3, *modify as follows*:**

[48] For example, a ~~minor weed~~ plant that is a minor pest may be significantly allergenic for humans or a minor plant pathogen may produce toxins that seriously affect livestock.

[49] **17. *In* Section 3. Stage 3: Pest Risk Management, *add at the bottom as new paragraph*:**

[50] More detailed guidance on pest risk management for plants as pests is provided in Annex 4.

[51] ***18.* *In* Section 3.4 Identification and selection of appropriate risk management options, paragraph 2, indent 2, *modify as follows:***

[52] - ~~weeds and/or invasive~~ plants as pests ~~and~~

[53] ***19.* *In* Section 3.4.1 Options for consignments, paragraph 3, *modify as follows:***

[54] *S1* The concept of consignments of pests may be applied to the import of plants ~~considered to be~~as pests. ~~These consignments~~Import may be restricted to species or varieties posing less risk.

[55] **20. *In* Section 3.4.5 Options within the importing country, paragraph 2, *modify as follows*:**

[56] *S1* For plants ~~to be imported~~as pests, where there is a high level of uncertainty regarding pest risk, it may be decided not to take phytosanitary measures at import, but only to apply surveillance or other procedures after entry (e.g. by or under the supervision of the NPPO).

[57] **21. *In* Section 3.6 Conclusion of pest risk management, *add at the bottom as new paragraph*:**

[58] More detailed guidance on risk communication for plants as pests is provided in Annex 4.

[59] **22. *In* Annex 1 Comments on the scope of the IPPC in regard to environmental risks, paragraph 1, sentence 2, *modify as follows*:**

[60] The coverage of the IPPC definition of plant pests includes ~~weeds~~ plants as pests, and other species that have indirect effects on plants, and the Convention applies to the

protection of wild flora.

[61] **23. *In* Annex 1 Comments on the scope of the IPPC in regard to environmental risks, paragraph 1, indent 2 ("indirectly affect plants") commentary, *modify as follows:***

[62] In addition to pests that directly affect host plants, there are those like most ~~weeds/invasive~~ plants as pests, which affect plants primarily by other processes such as competition (e.g. for cultivated plants: Canada thistle (*Cirsium arvense*) ~~[weed of agricultural crops]~~, or for uncultivated/unmanaged plants: Purple loosestrife (*Lythrum salicaria*)). ~~[competitor in natural and semi-natural habitats]).~~

[63] [1] Invasive alien plants, in the CBD sense, are plants introduced by human agency and threatening biodiversity (see ISPM 5, Appendix 1 (2009)). Weed usually refers to pests of cultivated plants. However, some countries use the term "weed" irrespective of whether cultivated plants or wild flora are at risk, whereas other countries use the term "noxious weed", "landscape weed", "environmental weed" or similar terms to distinguish from weeds affecting crops only.

[2] # ISPM 27:2006 DRAFT ANNEX XX: *TROGODERMA GRANARIUM* (201-)

[3]

Date of this document	29 April 2010
Document category	Draft new annex to ISPM 27:2006 (*Diagnostic protocols for regulated pests)*
Current document stage	Draft for member consultation 2011.
Origin	Work programme topic (2004-006): Insects and mites, CPM-1 (2006)
Major stages	Approved for member consultation by the SC
Consultation on technical level	The first draft of this diagnostic protocol was written by: The first draft of this protocol was written by Andras Szito (Department of Agriculture and Food Western Australia, Plant Biosecurity Branch, South Perth, Australia); Witold Karnkowski (Main Inspectorate of Plant Health and Seed Service, Central Laboratory, Toruń, Poland) and Alba Enrique de Briano (Laboratorio de Plagas y Enfermedades de las Plantas, SENASA, Buenos Aires, Argentina). This proposal has been reviewed by Dr. R. S. Beal Jr (Prescott, USA), Dr Marcin Kadej (Instytut Zoologiczny, Uniwersytet Wrocławski, Wrocław, Poland), Dr Alan V. Barak (USDA, APHIS, PPQ, CPHST- Otis Laboratory, Buzzards Bay MA, USA), Prof. Chris Haines (Natural Resources Institute, University of Greenwich at Medway, Kent, UK) and Dr. C. Ostoja-Starzewski (The Food and Environmental Research Agency, York, United Kingdom)
Main discussion points during development of the diagnostic protocol	N/A
Notes	Formatted in template of February 2010. Auto numbered ¶.

[4] ## Adoption

This diagnostic protocol was adopted by the Commission on Phytosanitary Measures in 20--.

[5] ## 1. Pest Information

[6] The Khapra beetle, *Trogoderma granarium* Everts (Coleoptera: Dermestidae), is a stored product pest of great importance. Its importance lies not only in its capabilities of causing serious damage to stored dry commodities but also in that countries having established populations of this pest face export restrictions for their produce.

[7] *Trogoderma granarium* is thought to have originated from the Indian subcontinent but it is present in some areas of Asia, the Middle East, Africa and Europe. For more detailed information about *T. granarium*, see the EPPO PQR database (EPPO, 2007). There have been multiple introductions to the United States and Mexico but these were successfully eradicated. It is one of the very few stored products pests that has limited worldwide distribution. *T. granarium* has very limited ability to spread without

human aid because it is unable to fly. It is very important to distinguish between records that relate to introductions and those of established infestations.

[8] The Khapra beetle may occur in various dry stored products of primarily vegetable origin. Primary hosts are cereals, buckwheat, cereal products, pulses, alfalfa, various vegetable seeds, herbs, spices and various nuts. It can successfully complete its life cycle in copra, dried fruits, various gums and many different dried products of wholly or partial animal origin such as milk powder, skins, dried dog food, dried blood, dead insects and dried animal carcasses. As a pest it is most prevalent under hot dry conditions where very heavy infestations can develop. In cooler and also in hot and humid conditions it tends to be out-competed as a pest by other species such as *Sitophilus* spp. and *Rhyzopertha dominica* (Fabricius). Commodities stored in bags in traditional warehouses are more at risk from this pest than bulk-stored commodities.

[9] There are important features of *T. granarium* biology that enable the pest to survive in harsh conditions.

[10] Khapra beetle can have between one and more than ten generations per year depending on food availability and quality, temperature and humidity. A complete life cycle may be as short as 26 days (temperature 32–35 °C) or as long as 220 days or more in a suboptimal environment. In temperate climates larvae become inactive at temperatures below 5 °C, so the pest is able to survive and breed only in protected environments. However, there are two genetic variations of larvae: those that are able to undergo facultative diapause and those that are unable to do so. Larvae of the first type are stimulated into diapause by adverse conditions such as low or high temperatures and/or lack of food. During diapause their respiration drops to an extremely low level leading to tolerance to fumigation. Diapausing larvae are also cold-hardy and may survive temperatures below −10 °C. Should favourable conditions return, the pest is able to multiply rapidly and cause serious damage to the commodity.

[11] *Trogoderma* species other than Khapra beetle may also be found in stored products, but only some of these feed on such products. Among these species the biggest economic losses are caused by *T. variabile* Ballion, which is recognized as a quarantine pest in some countries. However, most *Trogoderma* species occurring in stored products appear to be scavengers, feeding on dead bodies of other insects. During a 12-year survey conducted in California, eight species of *Trogoderma* were found in stored seeds, animal feed and grocery commodities (Strong and Okumura, 1966). Mordkovich and Sokolov (1999) mention other *Trogoderma* species that may be found in stored products. Among them, *T. longisetosum* Chao et Lee has been noted as a stored product pest in China. It is very similar to *T. glabrum* (Herbst). Some tropical *Trogoderma* species may also be present in stored products (Delobel and Tran, 1993). One of such species is *T. cavum*, which was described by Beal (1982) after examination of specimens infesting stored rice in Bolivia. Some species occurring in stored products closely resemble *T. granarium*.

[12] For more general information on *T. granarium*, see Hinton (1945), Lindgren *et al*. (1955), Pasek (1998), EPPO/CABI (1997), Berg (1999a), CABI (2005) and Walker (2008).

[13] Diagnostic protocols for *T. granarium* were published by two regional plant protection organizations – COSAVE (1999) and EPPO (2002). The initial point for preparation of this protocol was the document issued by EPPO (2002).

[14] ## 2. Taxonomic Information

[15] **Name:** *Trogoderma granarium* Everts, 1898

[16] **Synonyms:** *Trogoderma albonotatum* Reiche in Mulsant et Rey, 1868

[17] *Trogoderma quinquefasciata* Leesberg, 1906

[18] *Trogoderma khapra* Arrow, 1917

[19] *Trogoderma afrum* Priestner, 1951

[20] *Trogoderma granarium* ssp. *afrum* Attia & Kamel, 1965

[21] **Common names:** Khapra beetle (English)

[22] Trogoderme (dermeste) du grain, Dermeste des Grains (French)

[23] *Trogoderma* de los granos, Escarabajo Khapra, Gorgojo khapra (Spanish)

[24] خنفساء الحبوب الشعرية(Arabic)

[25] **Taxonomic position:** Insecta: Coleoptera: Dermestidae.

[26] ## 3. Detection

[27] *T. granarium* has the following life developmental stages: eggs on the surface of grain and other stored products; larvae (5–11 instars) in stored products (larvae may be found in packing material or within storage structures); pupae in stored products, in the last larval exuviae (cast skins); adults in stored products.

[28] Methods to detect *T. granarium* infestations include inspection (physical and visual search) and use of food baits or, more importantly, pheromone traps. Often the infested material contains only larvae. There are three reasons for this: (1) adult longevity is usually between 12 and 25 days, but can be as long as 147 days in unfavourable conditions, whereas larval longevity is usually 19–190 days (and can be up to six years should larvae go into diapause); (2) most of the dermestid larvae occurring in the stored product will partially or wholly consume dead adults; and (3) adults are most prevalent when conditions are favourable for population growth. Larval exuviae are usually not consumed so their presence is a clear indication of a possible active infestation. Larvae are extremely cryptic by nature. This is particularly so in the case of diapausing larvae, which can stay inactive for periods in cracks and crevices where they are very difficult or nearly impossible to locate.

[29] It should be mentioned that many other dermestid species belonging to other genera occur in stored products. Members of *Dermestes* and *Attagenus* genera are frequently found feeding on materials of animal origin, such as dog biscuits, dried meat, dried blood, as well as rat, mice and bird carcasses (also in the stores). *Anthrenus* and *Anthrenocerus* species can be serious pests of wool and woollen products. In stored products heavily infested by other stored products pests, non-pest *Trogoderma* will usually feed on these dead insects.

[30] Searches for this pest are particularly difficult in cases of low-level infestations. In contrast to most other stored products pests, the Khapra beetle prefers hot and dry areas. The larvae of *Trogoderma* species are very crepuscular, and populations can persist in small quantities of residues that may occur within a structure or mode of transport. Larvae in diapause can survive long periods without food. For diapausing larvae it is important to search under piles of dirt, flaking paint and rust, in empty packaging materials such as hessian bags, tarpaulins, and corrugated cardboard. Larvae are often hiding behind wall panelling, under internal lining, between floorboards, under insulation, on dry ledges, electrical cable trays and conduits, switch boxes etc. Larval exuviae become airborne very easily, and therefore it is always important to check window sills, grilles of venting holes and spider webs for their presence. Rodent traps containing baits should be always inspected.

[31] Khapra beetle infestations are usually recognized by (1) the presence of the pest (especially feeding larvae and exuviae) and (2) symptoms of infestation. The short-lived adults are sometimes not seen. Damage to the commodities can be a warning sign, but often it is a result of the feeding of other common stored products pests. Larvae usually feed first on the germ portion of cereal seeds and then on the endosperm. The seed coat is eaten in an irregular manner. In bulk commodities infestations usually concentrate in the surface layers, where numerous larval exuviae, broken setae and frass (excrements) are present. However, larvae can occasionally be found as deep as 3–6 m in bulk grain.

[32] Samples of suspect products have to be visually inspected in a well-lit area, using a 10× magnification hand lens. If no signs of *Trogoderma* infestation are found then larger samples of the product, whose size corresponds with the size of a given lot, should be passed over sieves with aperture sizes relevant to the particle size of the products. Usually sets of sieves of aperture sizes 1.0, 2.0 and 3.0 mm are used. The sifted material collected on particular sieves should be placed in Petri dishes and examined under at least 10× to 25× magnification through a stereoscopic microscope to detect the pest. This screening technique allows the detection of various developmental stages of the pest. However, some larvae feeding within grains may remain undetected. Therefore, it may become necessary to heat samples to 40 °C to drive pests out of the grains. Visual inspection is preferable because sieving can easily destroy or seriously damage dead adults and larval exuviae rendering the identification very difficult or impossible.

[33] Insects found should be picked up carefully with small forceps or collected using an aspirator. It is important to collect multiple specimens of the pest. Identification of larvae is difficult, and if the dissection of a single specimen is not successful and serious damage occurs to the mouthparts, then exact identification is impossible. Specimens should be placed in 70% ethyl alcohol.

[34] Additionally, it is possible to monitor the presence of *T. granarium* using various traps. Food-baited traps (containing oil seeds, peanuts, wheat germ etc.) or attractant traps (containing wheat germ oil) can be used to attract larvae. Traps can be as simple as offering hiding places for the larvae, such as pieces of corrugated cardboard or hessian bag placed on the floor. After finishing the monitoring, all the traps should be collected and destroyed. Adults may be detected with the use of pheromone traps where the pheromone capsule is combined with a non-drying sticky trap. However, the *Trogoderma* pheromone traps are not species-specific and attract many species of dermestid beetles (Saplina, 1984; Barak, 1989; Barak *et al.*, 1990; Mordkovich and Sokolov, 2000). Traps baited with pheromone and food bait are commercially available for these species.

[35] ## 4. Identification

[36] The genus *Trogoderma* includes according to Mroczkowski (1968) 117 species; according to Beal (1982)

115 species; and according to Háva (2003) 130 species. There are many other species of *Trogoderma* yet to be described. Great caution needs to be exercised with the synonymies established because few of them are based on detailed comparison of the type specimens.

[37] Identification of *Trogoderma* eggs and pupae based on external features is currently not possible. Insect eggs and pupae possess very few external features and therefore are poorly studied. Larval identification is difficult. It requires experience in identification and also good skills in dissection of small insects. Pupation takes place in the last larval cast. The larval exuviae can be used for identification, but one needs to be more cautious because the material is brittle. Adults are the easiest to identify, though misidentification by less experienced entomologists is still common.

[38] Adults in good condition can be identified under a stereomicroscope using 10× to 100× magnification. However, movement of the stored product, particularly cereals, will damage the dead adults. In most cases the legs and antennae will break off and also the setae on elytra and pronotum will be rubbed off. In the case of a damaged specimen with missing body parts or morphological features not visible, it is necessary to examine the genitalia. For reliable identification the genitalia should be always examined. Genitalia should be removed (section 4.2) and mounted on a cavity microscope slide temporarily using glycerol or (for a longer time) using Hoyer's mounting medium (50 ml water, 30 g gum arabic, 200 g chloral hydrate, 20 ml glycerine).

[39] For larval identifications the mouthparts should be dissected out (section 4.1). The larval exuviae and dissected mouthparts should be mounted on a cavity microscope slide using Hoyer's medium (Beal, 1960). Details of mounting procedures are included in section 4.1.

[40] Adult and larval dissection can be performed under 10× to 40× magnification using a stereomicroscope. For the examination of genitalia and larval mouthparts, particularly the papillae of the epipharynx, a good-quality compound microscope is necessary and must be capable of 400× to 800× magnification in bright field and phase contrast. Depending on the microscope, use of oil immersion may be necessary for satisfactory resolution.

[41] Methods have been developed for the identification of a limited number of pest *Trogoderma* species using both immunological (ELISA test) and molecular techniques. These cannot be used yet as quarantine diagnostic techniques for the determination of species within the *Trogoderma* genus.

[42] 4.1 Procedure for preparation of larvae and larval exuviae

[43] Before dissection the larva should be examined under a stereomicroscope. Size, body colour, arrangement and colour of setae should be recorded.

[44] For identification larvae should be mounted on Hoyer's medium on a microscope slide using the following method.

[45] At first place the specimen ventral side up on a microscope slide. Cut open the whole body along the mid-line from under the head capsule to the last abdominal segment using eye surgery scissors. Next put the larva into a test-tube containing 10% potassium hydroxide (KOH) solution and heat in a boiling water bath until it has become clear. Rinse thoroughly in warm distilled water. Remove all internal tissues using a very fine, short hair brush or the convex surface of a hooked tip of a no. 1 insect pin, or a loop formed from a micropin. All setae should be removed from one side of the 7th and 8th abdominal segment.

Remove the head capsule and put it back in the hot KOH solution for 5 minutes. Rinse the head capsule in warm distilled water. Dissection of the head can be performed in a few drops of Hoyer's or glycerol on a microscope slide or in water in an excavated glass block. Turn the head ventral side up and hold it to the glass with a blunt no. 1 insect pin. Remove the mandibles, maxillae and labial palpi using jeweller's forceps and micropins. Remove the epipharynx and antennae. Mount the head capsule and the mandibles in the cavity of the slide using Hoyer's. Mount the cleared skin, fully opened on the flat part of the microscope slide, next to the cavity. It is usually best done ventral side up. Epipharynx, antennae, maxillae and labial palpi should be mounted with the skin under the same cover slip. Mount all body parts on the same microscope slide. In the case of larval exuviae, before proceeding with the dissection soak the specimen in a 5% solution of any laboratory detergent (e.g. Decon 90) for about two hours and thoroughly rinse in distilled water. Cut the specimen open anteriorly and dissect out the mouthparts. They can be mounted directly in Hoyer's without clearing. Label slides immediately after mounting specimens and place them in an oven for a few days at 40 °C. After drying, ring the slides using any lacquer recommended for sealing of microscopic slides (e.g. Glyptol, Brunseal), or at least two layers of nail polish in order to prevent the Hoyer's from drying and possibly damaging the specimen.

[46] Permanent slides can be made using Euparal or Canada balsam for mounting, but these require a laborious dehydration process.

[47] The identification should be performed using a high-powered (at least 400×) compound microscope. Depending on the quality of the microscope, oil immersion may need to be used to achieve satisfactory resolution.

[48] ## 4.2 Procedure for preparation of adults

[49] Adult *Trogoderma* specimens may need to be cleaned before identification, with any laboratory detergent or by using an ultrasonic cleaner. If the specimen was caught in a sticky trap the glue can be dissolved using a number of solvents e.g. kerosene. These solvents can be removed from the specimen by any laboratory detergent.

[50] Before beginning the preparation soak the adult in warm distilled water for about an hour. Next remove abdomen while the specimen is still in the water using fine forceps. Dry the specimen and mount it on a cardboard rectangle, preferably laterally. (Gluing it on the side makes the specimen less exposed to damage and accessible for both dorsal and ventral examination.) Next cut the abdomen laterally open, leaving the last abdominal segment untouched. Place it in 10% KOH or sodium hydroxide (NaOH) solution in a hot water bath for about 10 minutes. Rinse the specimen in water and carefully remove the genitalia using hooked micropins. The abdomen should be glued onto the same cardboard rectangle with the insect, ventral side facing up. Usually the genitalia need to be macerated further in the caustic solution. Separate the aedeagus from the periphallic tergum and the 9th abdominal segment using micropins.

[51] Genitalia can be mounted on a microscope slide using Hoyer's mounting medium. The aedeagus should be mounted on a cavity microscope slide so it is able to retain its shape. Female genitalia can be mounted on a flat microscope slide.

[52] Slides and pinned insects should be labelled immediately after mounting the specimens. The slides should be placed in an oven for a few days at 40ºC. After drying all slides should be ringed (see 4.1).

[53] If there is no need for mounting the genitalia using a permanent or semi-permanent mounting agent they can be examined in a drop of glycerol on a microscope slide. After the identification the organs can be placed in a microvial in a drop of glycerol or glued onto the cardboard rectangle next to the abdomen.

[54] ## 4.3 Genera of the family Dermestidae frequently occurring in stored commodities

[55] Besides *Trogoderma*, other dermestid genera may also be found in stored products, such as *Anthrenus*, *Anthrenocerus*, *Attagenus* and *Dermestes*. The first step of diagnosis of collected specimens is identification to genus. Adults, and in some cases larvae, of these beetles can be identified using at least one of the keys of Mound (1989), Kingsolver (1991), Haines (1991), Banks (1994), Rees (2004) and/or Háva (2004). Genera of the North American Dermestidae can be identified using the key of Kingsolver (2002).

[56] The following simple keys quickly enable *Trogoderma* to be distinguished from four other dermestid genera commonly occurring in stored commodities. Distinguishing characters are illustrated in section 9, Figures 1 to 16.

[57] ### 4.3.1 Larvae

[58] 14. Urogomphi present on 9th abdominal segment, 10th segment sclerotized, cylindrical **Dermestes spp.**

[59] Urogomphi absent, 10th abdominal segment not sclerotized.....**2**

[60] 15. Dorsal surface without hastisetae, maxillary palp 4-segmented ***Attagenus* spp.**

[61] Dorsal surface with hastisetae (Figure 13(A)), maxillary palp 3-segmented **3**

[62] 16. Posterior margins of abdominal terga sinuate, or emarginate, tufts of hastisetae placed on posterior membranous parts of terga, 8th abdominal tergum without tufts of hastisetae ***Anthrenus* spp.**

[63] Posterior margins of terga not sinuate or emarginate, tufts of hastisetae placed on sclerotized tergal plates, 8th tergum with tufts of hastisetae **4**

[64] 17. Second antennal segment about twice as long as last segment, head of hastisetae at least three times as long as wide at the widest point ***Anthrenocerus* spp.**

[65] Second and last antennal segments subequal, head of hastisetae less than three times as long as wide at widest point ***Trogoderma* spp.**

[66] ### 4.3.2 Adults

[67] 18. Median ocellus absent **Dermestes spp.** (Figure 10)

[68] Median ocellus present.....**2**

[69] 19. Body covered with scale-like setae; antennal cavity filled by antennae, fully visible from anterior view (Figure 9(A)) **Anthrenus spp.** (Figure 12)

[70] Body covered with simple setae, some of them whitish, flattened (ensiform) but never scale-like....**3**

[71] 20. Antennal cavity completely closed behind, antennal club 3-segmented and well defined **Anthrenocerus spp.**

[72] Antennal cavity open behind or partially delimited by a posterior carina, antennae cavity much wider than antennae, not visible in anterior view (Figure 9(B))……...**4**

[73] 21. Antennal cavity open behind, posterior margin of hind coxa angulate, first segment of posterior tarsus shorter than second segment **Attagenus spp.** (Figure 11)

[74] Antennal cavity carinate posteriorly, posterior margin of hind coxa straight, arcuate or sinuate, first segment of posterior tarsus longer than second segment ***Trogoderma* spp.** (Figures 1(A), 3, 9(B)).

[75] ## 4.4 Identification of *Trogoderma* larvae

[76] Unfortunately, so far no key has been published for all known *Trogoderma* species. Several keys have been published for the economically important species. Banks (1994) published a key to adults and larvae of the genus *Trogoderma* associated with stored products, as well as keys to larvae and adults of some species found in warehouses. Beal (1960) constructed an identification key to larvae of 14 species of *Trogoderma* from different parts of the world, including stored products pests. Mitsui (1967) published illustrated keys for identification of larvae and adults of some Japanese *Trogoderma* species. Kingsolver (1991) and Barak (1995) published keys to adults and larvae of some dermestid beetles, including a few *Trogoderma* species.

[77] ### 4.4.1 Preliminary identification of *Trogoderma* larvae

[78] If all of the following features can be observed on the larva or exuviae it is very likely that the specimen is a *Trogoderma* species, and therefore it is warranted to check the detailed list of features listed in section 4.4.2:

[79]
- elongate, cylindrical, hairy larvae
- hastisetae present on sclerotized part of terga
- pretarsal setae on the ventral side of claws unequal
- antennal segments subequal.

[80] ### 4.4.2 Discriminating features of *Trogoderma* larvae

[81] Discriminating features of *Trogoderma* larvae below are adapted from Banks (1994), Beal (1954, 1960), Haines (1991), Hinton (1945), Kingsolver (1991), Lawrence (1991), Lawrence *et al.* (1999a), Okumura and Blanc (1955), Peacock (1993) and Rees (1943):

[82]
22. body elongated, cylindrical, somewhat flattened, roughly six times as long as wide, nearly parallel-sided but gradually tapering toward rear
23. head well developed, sclerotized, and hypognathous
24. three pairs of jointed legs present
25. pretarsal setae on the ventral side of claws unequal
26. very hairy, being covered with different types of setae hastisetae, spicisetae and/or fiscisetae

(Figures 13 and 15)

27. head of hastisetae not more than three times longer than wide (Figure 15)
28. numerous hastisetae on all nota and terga, with prominent tufts of erect hastisetae inserted on the posterolateral part of the tergal plates of abdominal segments 6 to 8 (in *Anthrenus* genus the tufts of hastisetae are inserted on the membrane behind the sclerotized part of terga 5, 6 and 7)
29. urogomphi absent.

[83] ## 4.5 Identification of *Trogoderma granarium* larvae

[84] ### 4.5.1 Identification key of *Trogoderma granarium* larvae

[85] Larvae of *T. granarium* (Figures 1(B), 1(C) and 16) may be separated from other *Trogoderma* species using the following short key. If necessary, larvae of other pest and a few non-pest species can be identified, or at least separated, with reasonable confidence using the keys of Beal (1956, 1960), Banks (1994) and Peacock (1993).

[86] 30. Epipharynx with 4 distal papillae, usually in a single sensory cup……**2**

[87] Epipharynx with 6 distal papillae……...**3**

[88] 31. Terga uniformly yellowish-brown, without greyish pigmentation at base of large spicisetae; acrotergites weakly sclerotized; antecostal suture on 8th abdominal segment almost always absent (if present, faint and usually broken); setae almost completely encircling basal antennal segment, second segment usually with a single seta, apical segment with sensory pores in basal quarter; hastisetae morphology as in Figure 15(A), (B) ***Trogoderma granarium*** **Everts**

[89] Terga usually dark greyish-brown, at least at base of major spicisetae; acrotergites brownish, sclerotized; antecostal suture on 8th abdominal segment distinct; second antennal segment without setae; hastisetae morphology as in Figure 15(C), (D) ***Trogoderma glabrum*** **(Herbst)**

[90] 32. Setae on basal antennal segment grouped on inner and inner-dorsal side leaving the outer and outer-ventral side glabrous; on fully extended antenna setae on basal segment not reaching apex of the second segment, sensory pore(s) on apical antennal segments not in basal quarter; median small spicisetae on acrotergites not long enough to extend over the antecostal suture (Figure 14(C); compare with Figure 14(D)); hastisetae (Figure 15(E), (F)) very sparse on thoracic and anterior abdominal terga (Figure 14(A)); terga with single row of large spicisetae (Figure 14(B)) ***Trogoderma variabile*** **Ballion**

[91] Specimen without above combination of characters **other *Trogoderma* spp.**

[92] Larval identification should be considered unreliable if it is based only on one specimen, or exuviae or worn specimens. This is because in many species the intraspecific variation is such that in individual specimens features considered specific to the species cannot be seen, while features specific to other species can be. In addition, large numbers of non-pest *Trogoderma* species occur in stored commodities and many of their characteristics are not well studied.

[93] ### 4.5.2 Discriminating features of *Trogoderma granarium* larvae

[94] Discriminating features of *T. granarium* larvae are as follows:

[95]
33. antennal segments subequal
34. setae of basal antennal segment almost completely encircling the segment, reaching or surpassing apex of second segment, at least three-fourths as long as the second antennal segment
35. second antennal segment of last instar usually with one seta
36. last antennal segment with at least one sensory pore in basal quarter
37. epipharynx with four papillae in distal sensory cup, usually in a single unit
38. fiscisetae absent
39. mesally directed tergal setae absent
40. at least six small spicisetae on first abdominal tergum posterior to antecostal suture anterior to large spicisetae
41. anterior-median small spicisetae anterior to antecostal suture not long enough to reach over the suture
42. large median spicisetae on first abdominal segment smooth or covered with inconspicuous scales with tips smooth for at least four times the diameter of seta
43. antecostal suture of 8th abdominal tergum almost always absent, but if present, faint and interrupted
44. antecostal suture on 7th abdominal tergum faint or interrupted
45. no greyish pigmentation on sides of thoracic and other segments, not even at the base of large lateral spicisetae.

[96]
4.5.3 Description of *Trogoderma granarium* larvae

[97] The first-instar larva (Figure 1(B)) is 1.6–1.8 mm long and 0.25–0.3 mm wide. Body is uniformly yellowish-white, head and hairs are reddish-brown. The mature larva (Figure 1(C)) is 4.5–6 mm long and 1.5 mm wide and body is reddish-brown. The larval body is covered with two kinds of hairs: spicisetae (Figure 13(B)), in which the shaft is covered with tiny, stiff, upwardly directed, pointed scales; and hastisetae (Figure 13(A)), in which the shaft is multi-segmented with spear-headed apex. Spicisetae are scattered over the dorsal surface of the head and body segments. Two groups of long spicisetae on the 9th abdominal segment form the tail. Hastisetae are found on all notal and abdominal segments, but on the last three or four segments they form distinctive, paired, erect tufts (Beal, 1960, 1991; EPPO/CABI, 1997).

[98]
4.6 Identification of *Trogoderma* adults

[99]
4.6.1 Preliminary identification of *Trogoderma* adults

[100] If all of the following features can be observed it is very likely that the specimen is a *Trogoderma* species; therefore it is warranted to check the detailed list of features listed in section 4.6.2:

[101]
- median ocellus present
- antennal cavity well defined by a posterior carina and open laterally
- antennal outline smooth (Figure 5(A)), antennal club at least three-segmented
- body hairy, elytra usually with three transverse bands of pale (ensiform) setae (setae of dead adults often rubbed off).

[102] ### 4.6.2 Discriminating features of *Trogoderma* adults

[103] The features below are adapted from Banks (1994), Beal (1954, 1960), Haines (1991), Háva (2004), Hinton (1945), Kingsolver (1991), Lawrence and Britton (1991, 1994), Lawrence *et al.* (1999b), Okumura and Blanc (1955) and Peacock (1993):

[104] 46. body ovate, densely setose, setae simple, usually 2–3 different types, recumbent, yellowish-white slightly flattened (ensiform) setae
47. presence of median ocellus
48. pronotum without lateral carina
49. antennal cavity of anteroventral surface not, or only slightly visible in anterior view (Figure 9(B))
50. antennal cavity carinate posteriorly at least to half of length and open laterally
51. prosternum forming a "collar" anteriorly
52. mesosternum deeply divided by sulcus
53. posterior margin of hind coxal plate curved or sinuate, never angulate
54. first segment of hind tarsus longer than second segment
55. antennae short, 9–11-segmented, with a 3–8-segmented club, antennal outline usually smooth or rarely flabellate, terminal segment never disproportionately enlarged
56. tarsi of all legs 5-segmented.

[105] ### 4.7 Identification of *Trogoderma granarium* adults

[106] The following short key elaborated by Andras Szito should be used to distinguish adult *T. granarium* from some other *Trogoderma* species frequently occurring in stored commodities. If necessary, other species can be identified with the keys of Beal (1954, 1956), Banks (1994), Kingsolver (1991) and Mordkovich and Sokolov (1999). These keys include species occurring in stored products and therefore may be used for identification of *Trogoderma* adults. It should be noted, that identification of adult sex of various *Trogoderma* species is practically possible only after dissecting of their genitalia (for morphology of male and female genitalia, see Figures 7 and 8). Checking of external distinguishing features as antennal club morphology should be performed on specimens surely identified to sex.

[107] ### 4.7.1 Identification key to *Trogoderma granarium* adults

[108] 57. Dorsal pubescence unicolorous **non-pest *Trogoderma* spp.**

[109] Dorsal pubescence not unicolorous but with pattern or pubescence completely rubbed off; (ensiform setae in addition to yellowish- and reddish-brown setae) ……..**2**

[110] 58. Elytra without well-defined pattern, unicolorous or vaguely mottled ……...**3**

[111] Elytra with well-defined lighter and darker areas (Figure 2) ……**4**

[112] 59. Integument black, rarely with vague brownish maculation, basal loop, submedian and subapical bands formed by yellowish and whitish, ensiform setae; antennae always 11-segmented, male

antennal club 5–7-segmented, female 4–5-segmented; 5th sternite of male with uniform, recumbent setae ***Trogoderma glabrum*** **(Herbst)**

[113] Integument light reddish-brown, often with indistinct lighter maculation, scattered ensiform setae rarely forming 2–3 indistinct bands; antennae usually 11-, rarely 9- or 10-segmented, male antennal club 4–5-segmented, female 3–4-segmented; 5th sternite of male with apical patch of dense, coarse setae ***Trogoderma granarium*** **Everts**

[114] 60. Elytral integument with distinct light basal loop ……..**5**

[115] Elytral integument with distinct bands and spots only ……**7**

[116] 61. **5.** Anterior margin of eyes distinctly emarginated ***Trogoderma inclusum*** **LeConte**

[117] Anterior margin of eyes straight or slightly sinuate ……..**6**

[118] 62. Basal loop never connected to the antemedian band ***Trogoderma variabile*** **Ballion**

[119] Basal loop of elytral maculation connected to the antemedian band by a longitudinal band or bands (*T. inclusum* with less obvious emargination of eyes may key out here) ***Trogoderma ornatum*** **(Say),**
T. simplex **Jayne,** ***T. sternale*** **Jayne,** ***T. versicolor*** **(Creutzer)**

[120] 63. Elytral integument with three well-defined (basal, submedian and apical) fasciae, setae on fasciae largely white, ensiform with very little yellowish recumbent setae ***Trogoderma angustum*** **(Solier)**

[121] Elytral integument with well-defined basal band and median spot ***Trogoderma variabile*** **reduced pattern** (Figure 4).

[122] Elytral fasciae usually form a more or less complete basal loop, ante-median and median bands and apical spots. Some specimens have a reduced elytral pattern where the basal loop is indicated by curved anterior band, antemedian and/or median bands by small spots, and apical spots are usually missing.

[123] For positive identification, all (especially in the case of damaged specimens) of the discriminating features should be observed.

[124] Genital dissections should be carried out because there is a large number of undescribed *Trogoderma* species; by examining the genitalia, the chances of misidentifications are significantly reduced.

[125] Matveeva (2001) provides additional features for separation of adults of *Trogoderma granarium* from *T. variabile* (Figures 3, 4) and *T. glabrum*. Size and morphology of hind wings can be useful for identifying damaged specimens and although considering of these two characteristics is not mandatory it helps to increase the certainty of identification based on other features (Figure 6). During dissection hind wings must be removed and mounted in glycerol or Hoyer's medium.

[126] Hind wings of the Khapra beetle are smaller (mean length is 1.9 mm as compared with 2.5 mm for *T. variabile* and *T. glabrum*); they are paler in colour with less visible venation; number of setae S1 on costal vein (mean = 10) is half that on *T. variabile* and *T. glabrum* (mean = 20–23); number of small setae S2 between costal vein and pterostigma (mean = 2, sometimes absent) is less that for *T. variabile* and *T.*

glabrum (mean = 8) (Figure 6).

[127] ### 4.7.2 Discriminating features of *Trogoderma granarium* adults

[128] Adults of *T. granarium* are oblong-oval beetles, 1.4–3.4 mm long and 0.75–1.9 mm wide. The head is deflexed, head and pronotum darker than elytra, legs and abdomen are brownish. The elytra are brown. Females are slightly larger than males and lighter in colour.

[129] To identify the adult stages of *T. granarium* correctly, specimens should correspond to the characters used to identify the family Dermestidae, the genus *Trogoderma* and the species *granarium*. These characters are as follows:

[130] 64. elytral cuticle unicoloured, usually light brown or reddish-brown, or vaguely mottled without a clearly defined pattern

65. elytral setae predominantly brown (Yellowish or white hairs forming no clearly defined banded pattern may also be present; these hairs are gradually rubbed off as the beetle moves around and the adult develops a shiny appearance.)

66. antennae with 9–11 segments; male antennal club with 4–5 segments; female antennal club with 3–4 segments (Figure 5)

67. inner eye margin straight or sinuate

68. male abdominal tergum 8 more or less evenly sclerotized, with setae along its margin sometimes tending to be grouped medially; tergum 9 with proximal margin of broader section almost U-shaped; tergum 10 with many long setae

69. serrate sclerites of bursa copulatrix of female small, not longer than corrugated part of spermatheca, with 10–15 teeth (Figure 8)

70. male genitalia with bridge straight, and evenly wide, broader at connections to the parameres (Figure 7(A)).

[131] ### 4.7.3 Description of *Trogoderma granarium* adults

[132] A *T. granarium* adult is illustrated in Figure 1(A).

[133] **Adult male**

[134] Body: Length 1.4–2.3 mm (mean 1.99 mm), width 0.75–1.1 (mean 0.95 mm,) mm, ratio of length to width about 2.1:1. Head and pronotum dark reddish-brown; elytra reddish-brown, usually with indistinct lighter reddish-brown fasciae. Venter of thorax and abdomen reddish-brown; legs yellowish-brown.

[135] Setae: Dorsal surface with evenly distributed, coarse, semi-erect, yellowish-brown and few, scattered, dark reddish-brown setae, with the colour of setae corresponding to the colour of the cuticle beneath; pronotum medially and laterally with indistinct patches of yellowish-white, ensiform setae, elytra with two or three indistinct bands of yellowish-white, ensiform setae. Ventral surface with dense, simple setiferous punctures, which are denser on ventrites, setae fine, short, recumbent, yellowish-brown.

[136] Head: Punctures large, largest anteriorly, ocellate, separated by a distance of about the diameter of one to

five punctures, surface between them shiny. Antennae yellowish-brown, 9-, 10- or 11-segmented with 4- or 5-segmented club. Antennal fossa shallow, loosely filled in by antenna. Eyes medially straight, or sometimes slightly sinuate.

[137] Thorax: Anterior margin of pronotum with row of yellowish-brown, coarse setae pointing to middle of anterior margin, setae on anterior half of disc pointing backward, on posterior half pointing to the scutellum. Punctures slightly larger and more dense along anterior and lateral margins, and medially, otherwise small, simple on disc and separated by about 2–4 diameters.

[138] Posterolateral end smooth, shining, otherwise very finely and densely punctured. Prosternum densely punctured, sides of posterior process straight and gradually tapering to apex.

[139] Elytra densely punctured by setiferous punctures, punctures small, denser laterally, on disc separated by 2–4 diameters, laterally by 1–2 diameters.

[140] Hind wings with vague venation; mean number of larger setae S1 on costal vein is 10, mean number of small setae S2 between costal vein and pterostigma is 2, but sometimes these missing.

[141] Tibiae with small spines along outer edge. Proximal segment of hind tarsus about same length as second; distal segment about twice as long as fourth segment.

[142] Abdomen: First ventrite with or without weak femoral lines. Ventrites covered by fine, yellowish-brown, recumbent setae, posterior half of penultimate ventrite with very dense, coarser, semi-erect, dark yellowish-brown setae.

[143] Genitalia: Distal end of median lobe of aedeagus shorter than apices of parameres. Parameres wide, with sparse, short setae on inner and outer margins, setae extending to half the length of aedeagus. Paramere bridge is located at about one third of the total length from distal end, straight distally and proximally, bridge is as wide or wider than aedeagus at crossing, basal process is tapered.

[144] **Adult female**

[145] Body: Length 2.1–3.4 mm (mean 2.81 mm); width 1.7–1.9 mm (mean 1.84 mm); ratio of length to width about 1.6:1.

[146] Antenna sometimes less than 11-segmented, club 3–4-segmented.

[147] Posterior half of penultimate ventrite without a dense fringe of semi-erect, yellowish-brown, coarse setae.

[148] Other external morphological characters as in male above.

[149] Genitalia: Bursa copulatrix with two small, dentate sclerites, length of sclerites equal to or shorter than the length of the corrugated part of spermatheca.

[150] ## 5. Records

[151] Records and evidence should be retained as described in section 2.5 of ISPM 27.

[152] In cases where other contracting parties may be adversely affected by the diagnosis, the records and evidence (in particular, preserved larvae and adults, slide-mounted specimens, photographs) should be kept for at least one year.

[153] ## 6. Contact Points for Further Information

[154] Further information on this protocol can be obtained from:

[155] Department of Agriculture and Food Western Australia, Biosecurity & Research Division, Plant Biosecurity Branch, Entomology Unit, 3 Baron-Hay Court, South Perth, WA 6151, Australia (tel: +61 8 9368 3248, +61 8 9368 3965; fax: +61 8 9368 3223, +61 8 9474 2840; e-mail: aszito@agric.wa.gov.au).

Main Inspectorate of Plant Health and Seed Service, Central Laboratory, Żwirki i Wigury 73, 87-100 Toruń, Poland (tel: +48 56 639 1110, +48 56 639 1115; fax: +48 56 639 1115; e-mail: wkarnkowski@piorin.gov.pl).

Laboratorio de Plagas y Enfermedades de las Plantas. Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA), Av. Ing. Huergo 1001, C1107AOK Buenos Aires, Argentina (tel: +54 11 4362 1177, extns 117, 118, 129 and 132; fax: +54 11 4362 1177, extn 171; e-mail: albabriano@senasa.gov.ar).

[156] ## 7. Acknowledgements

[157] The first draft of this protocol was written by Andras Szito (Department of Agriculture and Food Western Australia, Plant Biosecurity Branch, South Perth, Australia); Witold Karnkowski (Main Inspectorate of Plant Health and Seed Service, Central Laboratory, Toruń, Poland) and Alba Enrique de Briano (Laboratorio de Plagas y Enfermedades de las Plantas, SENASA, Buenos Aires, Argentina).

[158] ## 8. References

Banks, H.J. 1994. *Illustrated identification keys for* Trogoderma granarium, T. glabrum, T. inclusum *and* T. variabile *(Coleoptera: Dermestidae) and other* Trogoderma *associated with stored products*. CSIRO Division of Entomology Technical Paper, No. 32. Commonwealth Scientific and Industrial Research Organisation, Canberra. 66 pp.

Barak, A.V. 1989. Development of new trap to detect and monitor Khapra beetle (Coleoptera: Dermestidae). *Journal of Economic Entomology*, 82: 1470–1477.

—— 1995. Chapter 25: Identification of common dermestids. *In*V. Krischik, G. Cuperus & D. Galliart, eds. *Stored product management,*pp. 187–196. Oklahoma State University, Cooperative Extension Service Circular No. E-912 (revised).

Barak, A.V., Burkholder, W.E. & Faustini, D.L. 1990. Factors affecting the design of traps for stored-

products insects. *Journal of the Kansas Entomological Society*, 63(4): 466–485.

Beal, R.S. Jr. 1954. Biology and taxonomy of nearctic species of *Trogoderma. University of California Publications in Entomology,* 10(2): 35–102.

—— 1956. Synopsis of the economic species of *Trogoderma*occurring in the United States with description of new species (Coleoptera: Dermestidae). *Annals of the Entomological Society of America*, 49: 559–566.

—— 1960. *Descriptions, biology and notes on the identification of some*Trogoderma *larvae (Coleoptera, Dermestidae)*. Technical Bulletin, United States Department of Agriculture, No. 1226. 26 pp.

—— 1982. A new stored product species of *Trogoderma*(Coleoptera: Dermestidae) from Bolivia. *The Coleopterists Bulletin*, 36(2): 211–215.

—— 1991. Dermestidae (Bostrychoidea) (including Thorictidae, Thylodriidae). *In*F.W. Stehr, ed. *Immature Insects*, pp. 434–439. Duboque, Iowa, Michigan State University, Kendall/Hunt. Vol. 2, xvi+ 975 pp.

Berg, G.H. 1999a. *Trogoderma granarium* Everts. *In* OIRSA, *Hojas de Datos sobre Plagas y Enfermedades de Productos Almacenados de Importancia Cuarentenaria y/o Económica para los Países Miembros del OIRSA*, pp. 120–145. El Salvador, OIRSA. Vol. 6. 164 pp.

—— 1999b. *Trogoderma variabile*Ballion. *In*OIRSA, *Hojas de Datos sobre Plagas y Enfermedades de Productos Almacenados de Importancia Cuarentenaria y/o Económica para los Países Miembros del OIRSA*, pp. 146–161. El Salvador, OIRSA. Vol. 6. 164 pp.

CABI. 2005. *Trogoderma granarium*. *In* Crop Protection Compendium, CD-ROM, Wallingford, UK, CAB International. ISBN 085199086x, http://cabicompendium.org/cpc/home.asp.

COSAVE. 1999. *Trogoderma granarium* Everts, Ficha de procedimientos y métodos analiticos. COSAVE. 10 pp. (unpublished manuscript)

Delobel, A. & Tran, M. 1993. *Les coléopterés des denrées alimentaires entreposeés dans les régions chaudes*. Faune tropicale XXXII. Paris, ORSTOM. 424 pp.

EPPO/CABI. 1997. *Trogoderma granarium*. *In* I.M. Smith, D.G. McNamara, P.R. Scott, & M. Holderness, eds. *Quarantine pests for Europe*, 2nd edition. Wallingford, UK. CAB International. 1425 pp.

EPPO. 2002. Diagnostic protocols for regulated pests, *Trogoderma granarium*. *Bulletin OEPP/EPPO Bulletin*, 32: 299–310.

—— 2007. Plant Quarantine Data Retrieval System (PQR version 4.6). Paris, EPPO.

Green, M. 1979. The identification of *Trogoderma variable* Ballion, *T. inclusum* and *T. granarium* Everts (Coleoptera, Dermestidae), using characters provided by their genitalia. *Entomologists Gazette*, 30: 199–204.

Haines, C.P. (ed.) 1991. *Insects and arachnids of tropical stored products: their biology and identification (a training manual)*. Chatham Maritime, UK, Natural Resources Institute. 246 pp.

Háva, J. 2003. *World catalogue of the Dermestidae (Coleoptera)*. Studie a zprávy Okresního muzea Praha-Východ, 1:196 pp.

—— 2004. World keys to the genera and subgenera of Dermestidae (Coleoptera) with descriptions, nomenclature and distributional records. *Acta Musei Nationalis Pragae, Series B, Natural History*, 60(3–4): 149–164.

Hinton, H.E. 1945. *A monograph of the beetles associated with stored products*, Vol. 1. London, British Museum (Natural History). 443 pp.

Kingsolver, J.M. 1991. Dermestid beetles (Dermestidae, Coleoptera). *In* J.R. Gorham, ed. *Insect and mite pests in food. An illustrated key*, pp. 113–136. Washington, DC, USDA ARS and USDHHS,

PHS, Agriculture Handbook No. 655, Vol. 1: 324 pp.

—— 2002. Dermestidae. *In*R.H. Arnett Jr., M.C. Thomas, P.E. Skelley, & J.H. Frank, eds. *American beetles*, Vol. 2, pp. 228–232. Boca Raton, Florida, CRC Press. 861 pp.

Lawrence, J.F. 1991. Order Coleoptera. *In* F.W. Stehr, ed. *Immature Insects,* 2 vols. 1137 pp. Dubuque, Iowa, Kendall/Hunt, Vol. 2. xvi + 975 pp.

Lawrence, J.F. & Britton, E.B. 1991. Coleoptera (beetles). *In* C.S.I.R.O. ed. *Insects of Australia*, 2nd edition, Vol. 2, pp. 543–683. Carlton: Melbourne University Press. 2 vols. 1137 pp.

——. 1994. *Australian beetles.*Melbourne: Melbourne University Press. 192 pp.

Lawrence, J.F., Hastings, A.M., Dallwitz, M.J., Paine, T.A. & Zurcher E.J. 1999a. Beetle larvae of the world: descriptions, illustrations, and information retrieval for families and subfamilies. CD-ROM, Version 1.1 for MS-Windows. Melbourne: CSIRO Publishing.

—— 1999b. Beetles of the world: a key and information system for families and subfamilies. CD-ROM, Version 1.0 for MS-Windows. Melbourne: CSIRO Publishing.

Lindgren, D.L., Vincent, L.E. & Krohne, H.E. 1955. The Khapra beetle, *Trogoderma granarium* Everts. *Hilgardia*, 24(1): 1–36.

Matveeva, V.I. 2001. Идентификациа капрового жука, *Защита и карантин растиений*, 4: 31.

Mitsui, E. 1967. [On the identification of the Khapra beetle.] *Reports of the Japan Food Research Institute, Tokyo*, 22: 8–13. (in Japanese)

Mordkovich, Ya.B. & Sokolov, E.A. 1999. Определитель карантинных и других опасных вредителей сырья, продуктов запаса и посевного материала, Колос, Москва: 384.

—— 2000. Выявление капрового жука в складских помещниях, *Защита и карантин растиений*, 12: 26–27.

Mound, L. (ed.) 1989. *Common insect pests of stored food products. A guide to their identification*. London, British Museum (Natural History). 68 pp.

Mroczkowski, M. 1968. Distribution of the Dermestidae (Coleoptera) of the world with a catalogue of all known species, *Annales Zoologici,* 26(3): 1–191.

Okumura, G.T. & Blanc, F.L. 1955. Key to species of *Trogoderma* and to related genera of Dermestidae commonly encountered in stored grain in California. *In* California Legislature Joint Interim Committee on Agricultural and Livestock Problems*, Special Report on the Khapra Beetle,* Trogoderma granarium, pp. 87–89. Sacramento, California.

Pasek, J.E. 1998. *Khapra beetle (*Trogoderma granarium *Everts): pest-initiated pest risk assessment*. Raleigh, NC, USDA. 46 pp.

Peacock E.R. 1993. *Adults and larvae of hide, larder and carpet beetles and their relatives (Coleoptera: Dermestidae) and of derontid beetles (Coleoptera: Derontidae)*. Handbooks for the identification of British insects No. 5, Royal Entomological Society, London. 144 pp.

Rees, B.E. 1943. *Classification of the Dermestidae (larder, hide, and carpet beetles) based on larval characters, with a key to the North American genera*. USDA Miscellaneous Publication No. 511. 18 pp.

Rees, D.P. 2004. *Insects of stored products*. Melbourne, Australia, CSIRO Publishing; London, UK, Manson Publishing. viii +181 pp.

Saplina, G.S. 1984. Обследование складских помещений с помощью ловушек. *Защита растиений***,** 9: 38.

Strong, R.G. & Okumura, G.T. 1966. *Trogoderma* species found in California, distribution, relative abundance and food habits. *Bulletin, Department of Agriculture, State of California,* 55: 23–30.

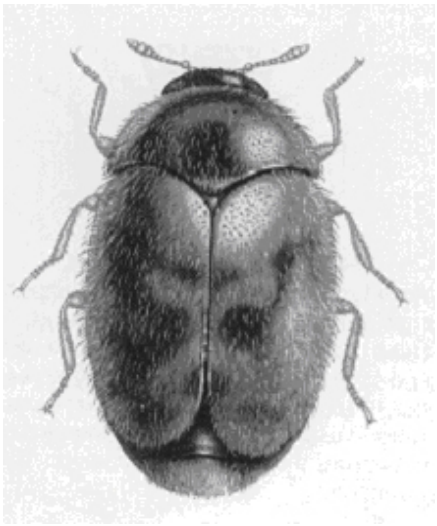
Varshalovich, A.A. 1963. Капровый жук – опаснейший вредитель пищевых запасов. Сельхоиздат,

Москва: 1–52.

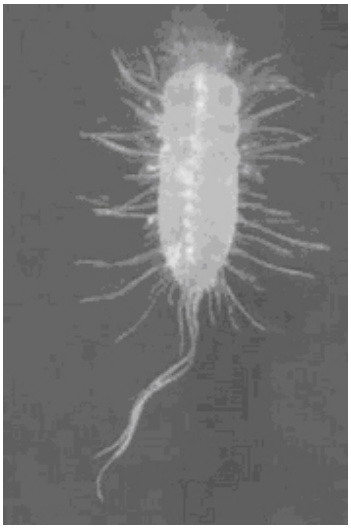
Walker, K.2008. Khapra beetle *(Trogoderma granarium).*Pest and Diseases Image Library (PaDIL), available online: http://www.padil.gov.au/viewPestDiagnosticImages.aspx?id=124, accessed 10 July 2008.

[159] **9. Figures**

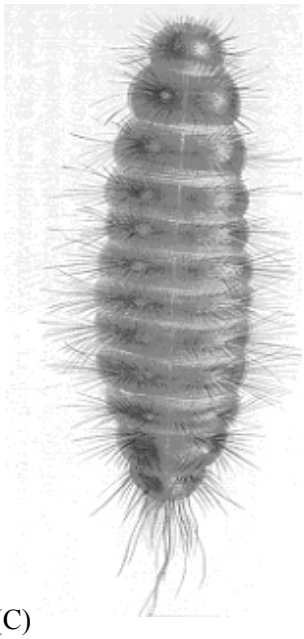
[160]



(A)



(B)



(C)

Figure 1:***Trogoderma granarium***:(A) adult, (B) young larva, (C) mature larva ((A), (C), ICI Plant Protection Division; (B), Cornel Adler, BBA, Germany)

[161]

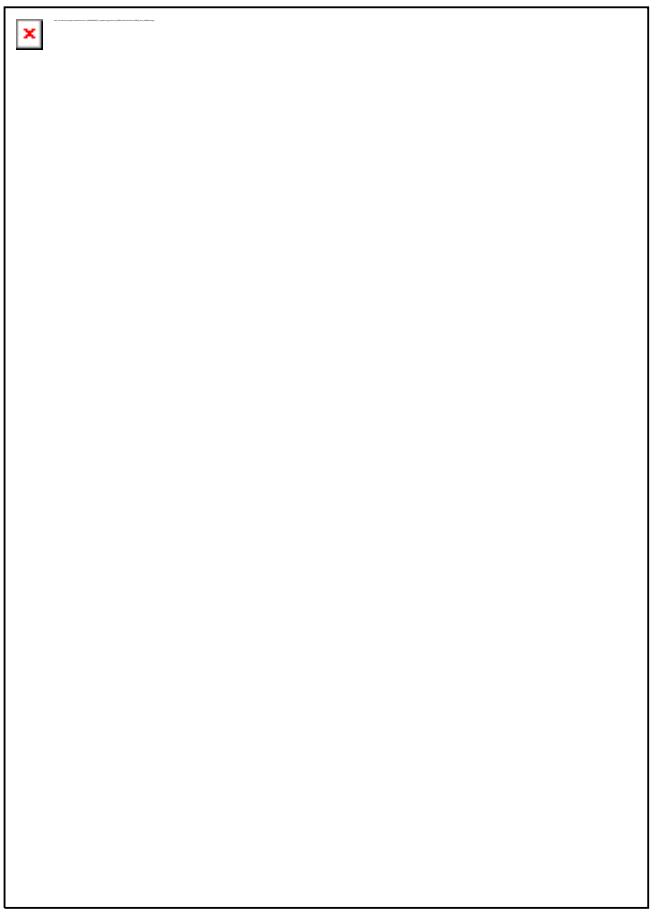


Figure 2: ***Trogoderma* spp**. elytral pattern (Beal, 1954)

[162]

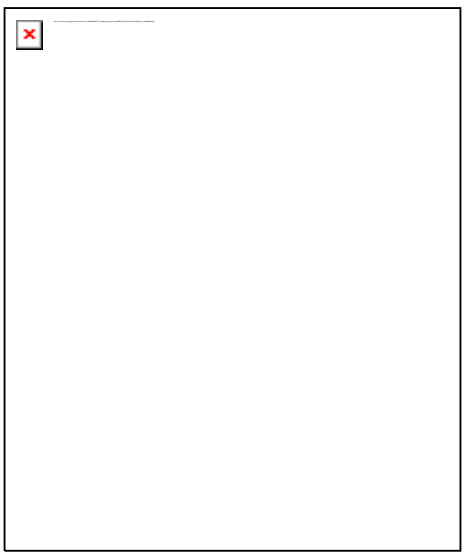
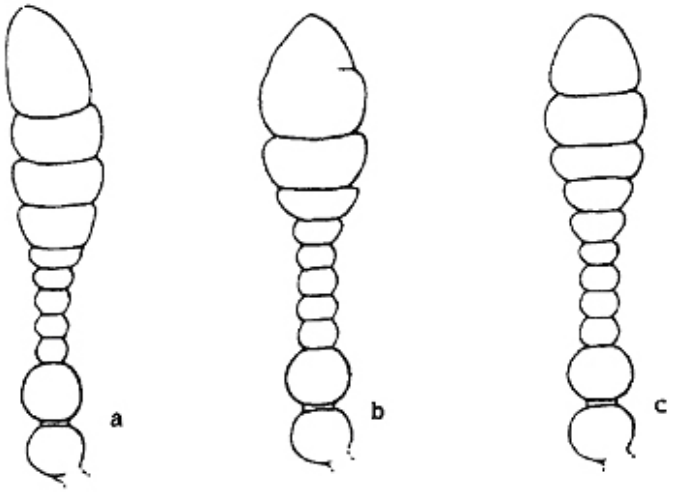


Figure 3: **Adult of *Trogoderma variabile*** (Berg, 1999b)

[163]

Figure 4: **Elytral pattern of *Trogoderma variabile*** (Beal, 1954)

[164]



[165]

Figure 5: Antennae of *Trogoderma granarium:* (A) male antenna with normal number of segments; (B) female antenna with reduced number of segments; (C) female antenna with normal number of segments (Beal, 1956)

[166]

Figure 6: Morphology of hind wing: comparison of morphology of hind wing of (A) *Trogoderma variabile* and *T. glabrum* with (B) *T. granarium* (Matveeva, 2001)

[167] Details: 1, general morphology of the wing; 2, enlarged anterior part of the wing; C, costal vein; P, pterostigma; S1, setae on costal vein; S2, small setae between costal vein and pterostigma.

[168]

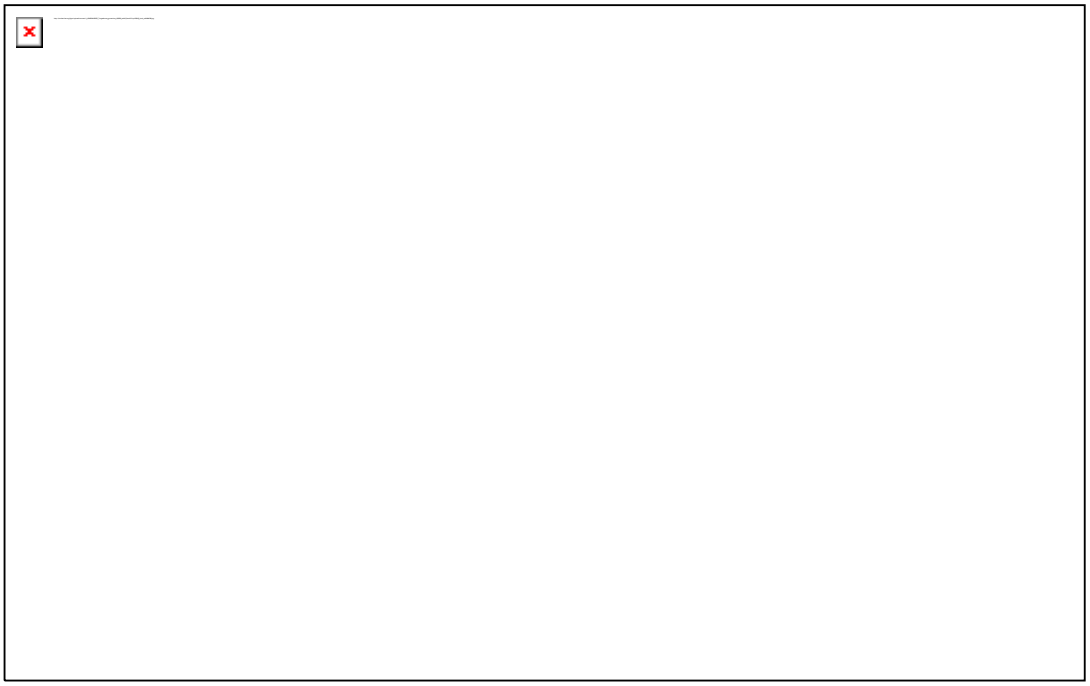


Figure 7: Male genitalia: (A) *Trogoderma granarium*, (B) *T. inclusum*, (C) *T. variabile* (Green, 1979)

[169]

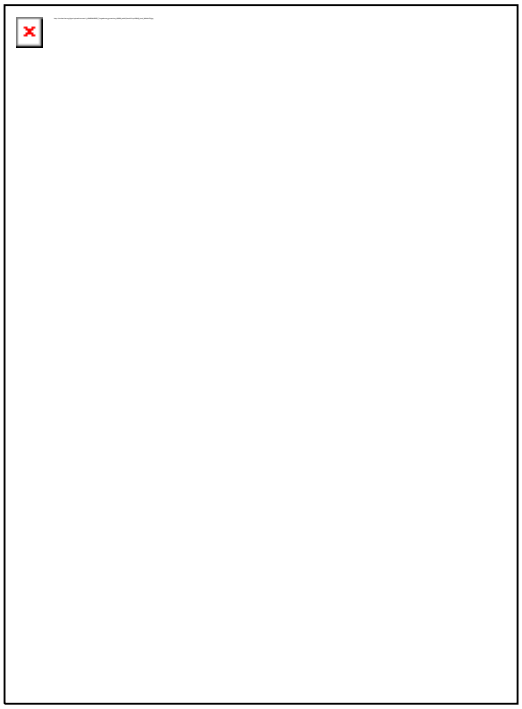
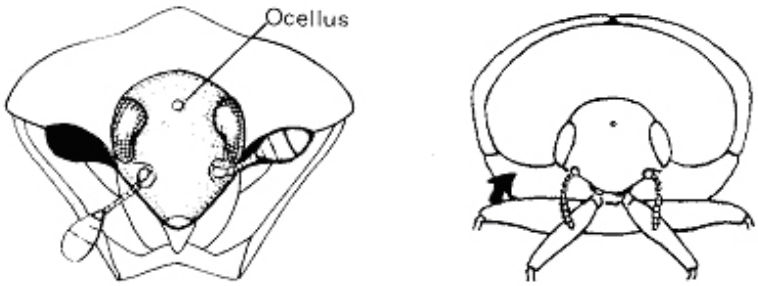


Figure 8: Female genitalia of *Trogoderma granarium:* (A) general view of genitalia; (B) one of the serrate sclerites from the bursa copulatrix (Varshalovich, 1963)

[170] Details: 1, ovipositor; 2, 7th abdominal sclerite; 3, vagina; 4, bursa copulatrix; 5, oviduct; 6, two serrate sclerites on bursa copulatrix; 7, corrugated part of spermatheca; 8, spermatheca; 9, accessory glands.

[171]



(A) (B)

[172] **Figure 9: Antennal cavity:** (A) antennal cavity clearly visible in anterior view (*Anthrenus*), antennae fully filling the cavity; (B) antennal cavity not visible in anterior view (*Trogoderma*), antennae loosely fit in the cavity ((A), Mound (1989); copyright: Natural History Museum, London, UK; (B), Kingsolver (1991))

[173]

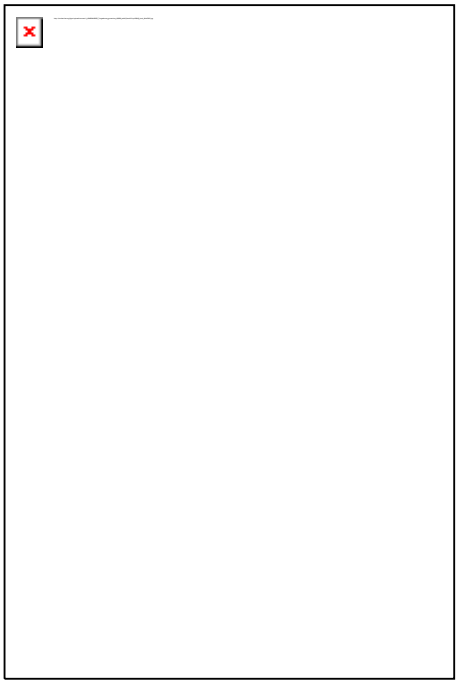


Figure 10: Adult *Dermestes lardarius*; copyright: Ministry of Agriculture Fisheries and Food, UK (Haines, 1991)

[174]

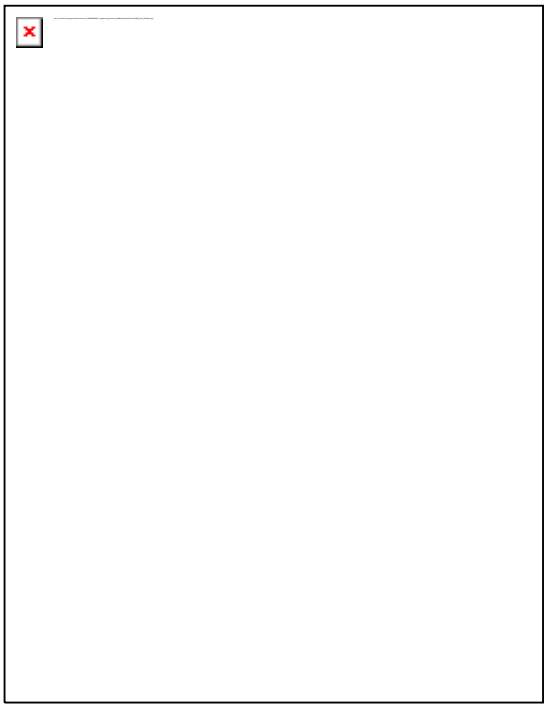


Figure 11: Adult *Attagenus* sp.; copyright: Natural History Museum, London, UK (Haines, 1991)

[175]

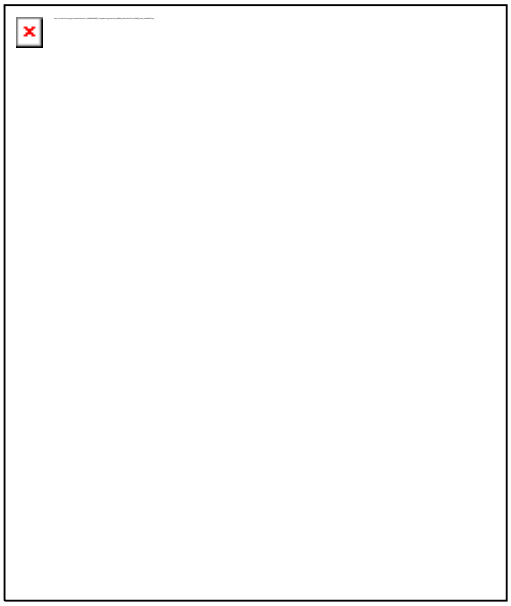


Figure 12: Adult *Anthrenus verbasci*; copyright: Natural History Museum, London, UK (Haines, 1991)

[176]

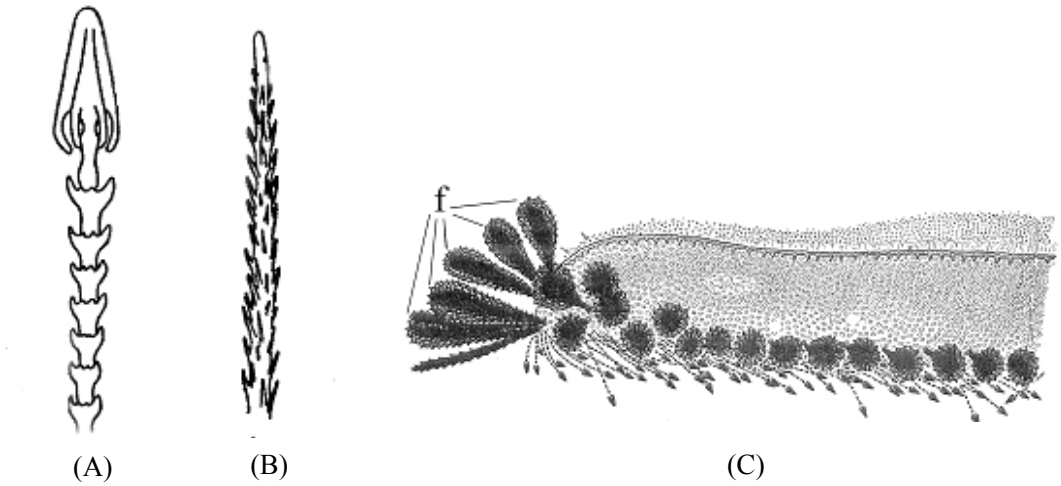


Figure 13: Larval setae: (A) hastiseta, (B) spiciseta, (C) fiscisetae (f) on first abdominal tergum of *Trogoderma carteri* larva ((A), (B), Varshalovich (1963); (C), Beal (1960))

[177]

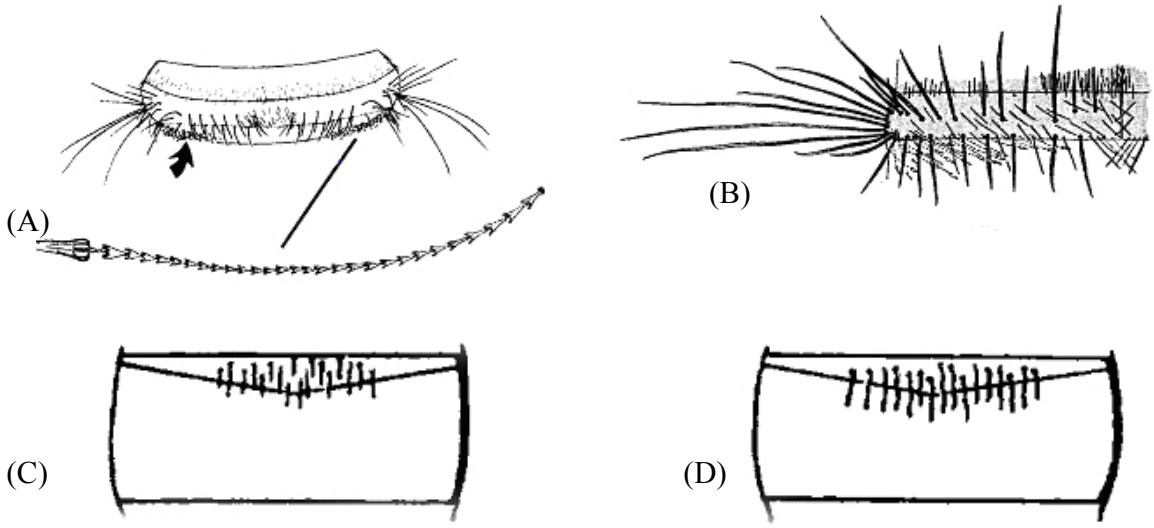


Figure 14: Abdominal tergite and setae: (A) abdominal tergite of *Trogoderma variabile* larva with enlarged hastiseta; (B) first abdominal tergite of *T. variabile* larva; (C) setae of the anterior portion of first abdominal tergite not long enough to extend caudally over the antecostal suture (*T. variabile*); (D) the same setae long enough to extend caudally through the antecostal suture (*T.* non-*variabile*) ((A), Kingsolver (1991); (B), Beal (1954); (C), (D), Berg (1999a))

[178]

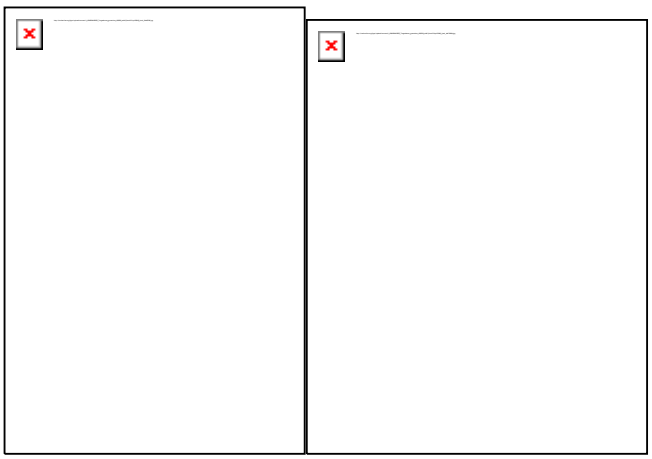


Figure 15: Comparison of hastisetae morphology of various *Trogoderma* species: (A), (B) *T. granarium*; (C), (D) *T. glabrum*; (E), (F) *T. variabile*; (G), (H) *T. inclusum*; copyright: Natural History Museum, London, UK (Peacock, 1993)

[179]

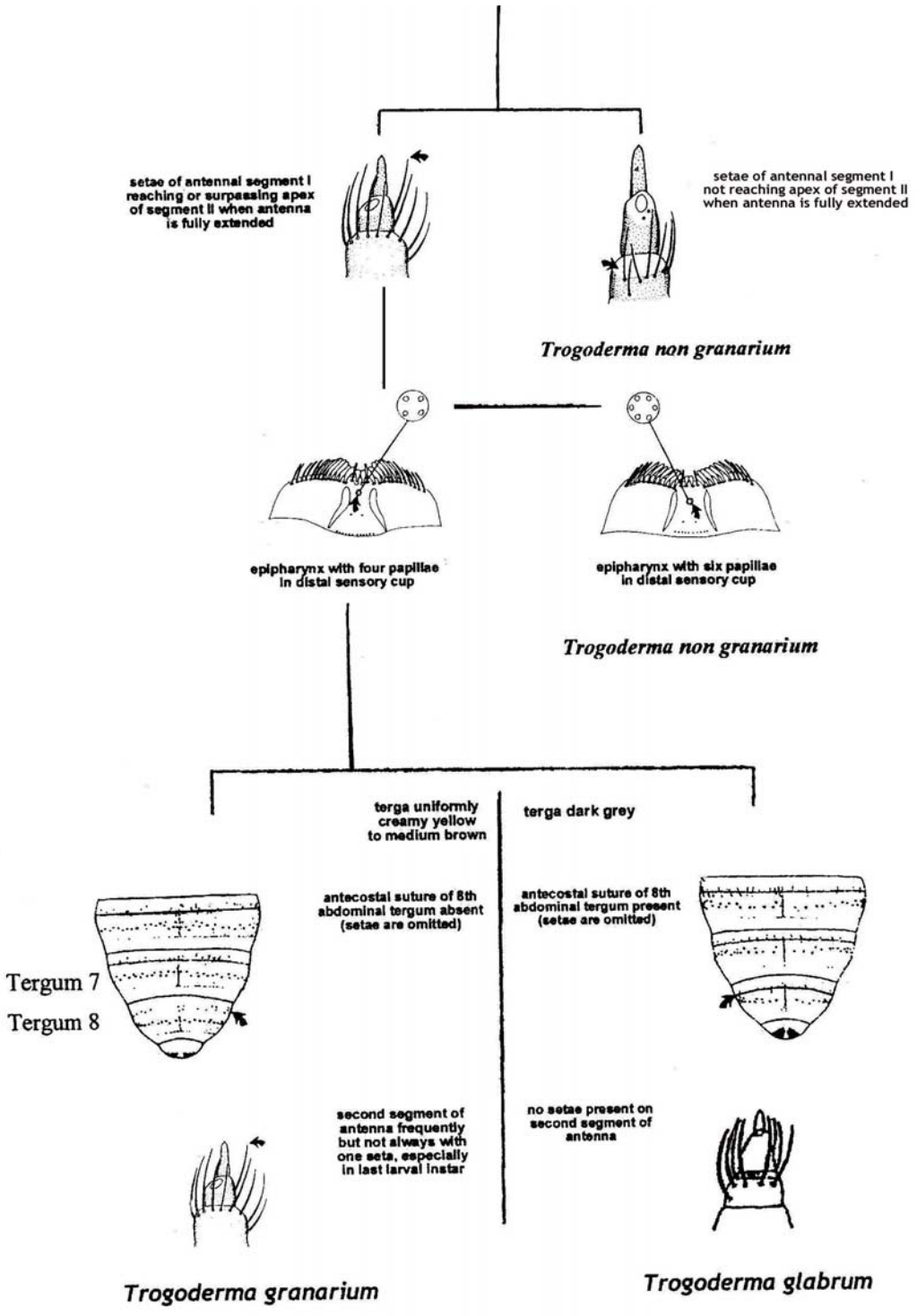


Figure 16: Pictorial key for distinguishing larvae of *Trogoderma granarium*from other *Trogoderma* spp.(Berg (1999a); Kingsolver (1991))

[2] **DRAFT AMENDMENTS TO ISPM 5 (GLOSSARY OF PHYTOSANITARY TERMS)**

[3]

Date of this document	6 May 2011
Document category	Amendments to ISPM 5 (*Glossary of phytosanitary terms*)
Current document stage	SC May 2011 approved draft for member consultation 2011
Origin	Work programme topic: Amendments to ISPM 5 (Glossary of phytosanitary terms) CEPM (1994)
Major stages	Specification TP5. Draft for member consultation, SC May 2011
Notes	12 February 2011: developed by the IPPC TPG at its October 2010 meeting. 27 February 2011: edited. Formatted for SC May 2011 on 1 March 2011. Copy edited after SC May 2011 on 6 May 2011.

Members are asked to consider the following proposals for additions, revisions and deletions in ISPM 5. Brief explanations are given for each proposal.

[4] ## 1. Additions

[5] ### 1.1 Confinement

[6] Background. The term *confinement* was added to the work programme by the SC in April 2010 based on the TPG proposal to develop a definition for *confinement* in relation to ISPM 3:2005 (*Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms*) and ISPM 34:2010 (*Design and operation of post-entry quarantine stations for plants*). A draft definition was proposed by the TPG in October 2010 and reviewed by the SC in May 2011. The following points may be considered:

[7]
- *Confinement* is now the term used in ISPM 34:2010. When the draft of that ISPM had been sent for member consultation, some member comments had suggested using *containment*. However, it was recommended that there was a need for two terms as used in the IPPC context with their current meaning, i.e. *containment* in relation to areas and *confinement* in relation to a facility.

- As in the definition of *containment*, it is the process of *confinement* that is described, not the result.

- Measures are not *phytosanitary measures*. Confinement might have a wider use than for regulated pests. It might also be used as a preventive measure, with no specific pest being directly targeted.

- *Confinement* is used to retain a pest in a quarantine facility or a regulated area, while *containment* aims at keeping it out of an area.

It is recommended to not mention *regulated pests* or *quarantine* as confinement might have a

broader use.

[8] Proposed addition

[9]

confinement	Application of **official** measures to a **regulated article** to prevent the escape of **pests**

[10] ## 1.2 Exclusion

[11] Background. In 2009, the Technical Panel for Fruit Flies (TPFF) developed a proposal for a definition for *exclusion* in the draft ISPM on phytosanitary procedures for fruit fly management**.** The term was added to the work programme by the SC in April 2010 based on a TPG proposal. The TPFF definition was reviewed and modified by the TPG in October 2010 and reviewed by the SC in May 2011. The following points may be considered:

[12]
- The definition should be broad as the term has a wider application than only fruit fly management. It is useful to have a definition of this term, in a similar way as there are definitions for *eradication* and *suppression*.
- It is recommended to use *phytosanitary* and not *official* measures. Although *official* might have been more appropriate for such measures applied against pests within a country, the definitions of *eradication* and *suppression* use *phytosanitary measures*, and it is not be desirable to introduce inconsistency between the three definitions.
- The term *introduction* (i.e. *entry* and *establishment*) is used and not *entry*. A package of exclusion measures might include measures to prevent *establishment* in cases of transience or incursion.

As the definition of *introduction* already refers to an area, it is recommended to not refer to an area in the definition.

[13] Proposed addition

[14]

exclusion	Application of **phytosanitary measures** to prevent the **introduction** of a **pest**

[15] ## 2. REVISIONS

[16] For revised terms and definitions, explanations of the changes made to the last approved definition are also given. It is suggested that any member comments should relate only to the changes proposed.

[17] ## 2.1 Absorbed dose

[18] Background. The October 2010 TPG identified this revision when reviewing ISPM 5 for the consistency in the use of terms. This change is not considered a consistency change as described in the report of CPM-4 (2009) so it is proposed as an amendment to the Glossary. The following points may be considered:

[19] - *Absorbed dose* is a physical term with no specific IPPC meaning, which normally would not be part of ISPM 5. It is however recommended to retain it, as it is not easily understood and is of great importance in relation to ISPM 18:2003 (*Guidelines for the use of irradiation as a phytosanitary measure*) and to treatments in ISPM 28:2007 (*Phytosanitary treatments for regulated pests*).

- The modification corrects a technical error. Gray is the quantity of radiating energy absorbed per unit of mass, i.e. the unit applies to the entire definition and not to "radiating energy" as in the old definition (the unit of radiating energy is joule).

It is recommended to retain the unit gray in the definition, although this is not normal practice in a definition. This is a special case as users might not be familiar with it.

[20] Original definition

[21]

absorbed dose	Quantity of radiating energy (in **gray**) absorbed per unit of mass of a specified target [ISPM No. 18, 2003]

[22] Proposed revision

[23]

absorbed dose	Quantity of radiating energy absorbed per unit of mass of a specified target (in gray)

[24] ## 2.2 Consignment in transit

[25] Background. The revised definition was proposed by the TPG in October 2010, with the purpose of ensuring consistency with the proposed revision of *re-exported consignment* and with the rules for developing definitions. The following points may be considered:

[26] - The proposal brings consistency with the revision of *re-exported consignment* (see 2.5) (the change from *which* to *that* is a simple editorial and is in line with the usual English style in ISPMs).

The second part of the current definition (*and that may be subject to phytosanitary measures*) expresses requirements. This is not appropriate for a definition, and requirements are explained in ISPM 25:2006 (*Consignments in transit*).

[27] Original definition

[28]

consignment in transit	A **consignment** which passes through a country without being imported, and that may be subject to **phytosanitary measures** [FAO, 1990; revised CEPM, 1996; CEPM 1999; ICPM, 2002; ISPM No. 25, 2006; formerly **country of transit**]

[29] Proposed revision

[30]

consignment in transit	A **consignment** that passes through a country without being imported.

[31] ## 2.3 Phytosanitary certificate

[32] Background. The term was added to the work programme by the SC in April 2010 based on TPG proposal. A revised definition was proposed by the TPG in October 2010 and reviewed by the SC in May 2011. The following points may be considered:

[33]
- The current terms *certificate* and *phytosanitary certificate* are interrelated in the Glossary, *certificate* being used in the definition of *phytosanitary certificate*.
- *Phytosanitary certificate* is the term of specific IPPC relevance and its definition currently lacks its specific IPPC meaning (currently expressed in the definition for *certificate*), i.e. that it attests that a consignment meets phytosanitary import requirements. It was therefore proposed to merge and further adjust *certificate* into *phytosanitary certificate* (deletion of *certificate* is proposed under 3.2).
- The proposed revision covers phytosanitary certificates in paper form and in electronic form and uses wording consistent with ISPM 12:2011 (*Phytosanitary certificates*). The original wording had to be adjusted as *document* (in the original definition of *certificate*) does not cover electronic phytosanitary certificates. The word *official* is used in both cases to indicate NPPO control.

Rewording of the last part reflects that the consignment is subject to phytosanitary import requirements and uses wording in line with ISPM 12:2011.

[34] Original definition

[35]

Phytosanitary Certificate	**Certificate** patterned after the model **certificates** of the **IPPC** [FAO, 1990]

[36] Proposed revision

[37]

phytosanitary certificate	An **official** paper document or its **official** electronic equivalent, patterned after the model certificates of the **IPPC**, attesting that a **consignment** meets **phytosanitary import requirements**

[38] ## 2.4 Quarantine station

[39] Background: Revision was proposed by the TPG (June 2009) and by the SC (November 2009). The term was added to the work programme by the SC in April 2010. A revised definition was proposed by the TPG in October 2010 and reviewed by the SC in May 2011. The following points may be considered:

[40] - The current definition is too restrictive as quarantine stations might be used to hold in quarantine not only plants or plant products, but also other regulated articles including beneficial organisms. Mention of other regulated articles and of beneficial organisms was added.

It is recommended to specifically mention beneficial organisms, as it is important in relation to ISPM 3:2005 (*Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms*). It should be noted that ISPM 3:2005 currently uses the words quarantine facilities to refer to the concept of quarantine stations. For consistency in the use of terms, once the revised definition is adopted, ISPM 3:2005 could be adjusted for consistency to use quarantine station.

[41] Original definition

[42]

quarantine station	**Official** station for holding **plants** or **plant products** in **quarantine** [FAO, 1990; revised FAO, 1995; formerly **quarantine station or facility**]

[43] Proposed revision

[44]

quarantine station	**Official** station for holding **plants, plants products** or other **regulated articles**, including beneficial organisms, in **quarantine**

[45] ## 3. DELETIONS

[46] ### 3.1 Certificate

[47] Background. The term was added to the work programme by the SC in April 2010 based on a TPG proposal. Deletion was proposed by the TPG in October 2010 and reviewed by the SC in May 2011.

[48] The current definition of *certificate* limits it to the IPPC context, but *certificate* and *certification* on their own have other meanings that need to be used in ISPMs (e.g. *CITES certificate* in ISPM 12:2011; *treatment documents/certificates, certificate of origin* in ISPM 23:2005; *certification of facilities* in ISPM 18:2003). Deletion of the term and definition is therefore proposed so as to not limit the use of the term. The proposed revision of the definition of *phytosanitary certificate* (see 2.3) ensures that the term of specific IPPC relevance is defined.

[49] Proposed for deletion

[50]

certificate	An **official** document which attests to the phytosanitary status of any **consignment** affected by **phytosanitary regulations** [FAO, 1990]

[51] ### 3.2 Gray (Gy)

[52] Background: The term was added to the work programme by the SC in April 2010 based on a TPG proposal. Deletion was proposed by the TPG in October 2010 and reviewed by the SC in May 2011.

[53] The term "*gray (Gy)*" appears in the (incorrect) Glossary definition of *absorbed dose* (see 2.X), in ISPM 18:2003 and in ISPM 28:2007 (all annexes). G*ray* as the unit of absorbed dose is defined in the International System of Units (i.e. an SI-unit) and therefore need not be defined in the Glossary.

[54] Proposed for deletion

[55]

gray (Gy)	Unit of **absorbed dose** where 1 Gy is equivalent to the absorption of 1 joule per kilogram (1 Gy = 1 $J.kg^{-1}$) [ISPM No. 18, 2003]

[56] ### 3.3 Hitch-hiker pest

[57] Background: The term was added to the work programme by the SC in April 2010 based on a TPG proposal. Deletion was proposed by the TPG in October 2010 and reviewed by the SC in May 2011.

[58] The current definition ("See contaminating pest") simply states that *hitch-hiker pest* should be understood as identical to *contaminating pest*. The term *hitch-hiker pest* does not appear in the IPPC or ISPMs. The term is not easily understood by non-native English speakers and difficult to translate in a meaningful way. It need not be defined in the Glossary.

[59] Proposed for deletion

[60]

hitch-hiker pest	See **contaminating pest**

[61] ### 3.4 Legislation

[62] Background: The term was added to the work programme by the SC in April 2010 based on a TPG proposal. Deletion was proposed by the TPG in October 2010 and reviewed by the SC in May 2011.

[63] The term *legislation* appears in the Convention Article II.1 in the definition of *phytosanitary measures*, in the definition of *phytosanitary legislation*, and in ISPMs 3:2005, 5, 12:2011, 18:2003, 19:2003, 20:2004 and 25:2006. Whereas the Glossary terms *phytosanitary legislation*, *phytosanitary measures* and *phytosanitary regulation* are defined with a particular meaning pertaining to the IPPC domain, the term *legislation* is a broadly used and understood term without any specific usage in the ISPMs. It need not be defined in the Glossary.

[64] Proposed for deletion:

[65]

legislation	Any act, law, regulation, guideline or other administrative order promulgated by a government [ISPM No. 3, 1996]

[66] ## 3.5 Plant pest

[67] Background: The term was added to the work programme by the SC in April 2010 based on a TPG proposal. Deletion was proposed by the TPG in October 2010 and reviewed by the SC in May 2011.

[68] The current definition ("See pest") states that *plant pest* should be understood as identical to the term *pest*, which is defined in the Convention itself. The term *plant pest* appears in the Convention Articles I.4, VII.5 and VIII.1(a). It also appears in ISPMs 2:2007, 3:2005, 5, 6:1997, 11:2004, 15:2009 and 17:2002. In all cases, the term is correctly used as synonymous to *pest*. *Plant pest* could be substituted by *pest* during revisions of ISPMs for consistency or revision. The use of two synonymous terms should be avoided, and only the term defined in the IPPC used.

[69] Proposed for deletion

[70]

plant pest	See **pest**

[71] **Note on other deletions**

[72] Deletions proposed in 3.6 to 3.11 below were identified when reviewing ISPM 5 for the consistency in the use of terms. These deletions are not considered consistency changes as described in the report of CPM-4 (2009) so they are proposed as amendments to the Glossary.

[73] ## 3.6 Antagonist

[74] Background: The October 2010 TPG identified these deletions when reviewing ISPM 5 for the consistency in the use of terms. The following may be considered:

[75] This term and definition do not have a specific meaning in the IPPC context, and are not needed in the Glossary.

[76] Proposed for deletion

[77]

antagonist	An **organism** (usually **pathogen**) which does no significant damage to the host but its colonization of the host protects the host from significant subsequent damage by a **pest** [ISPM No. 3, 1996]

[78] ## 3.7 Competitor

[79] Background. The October 2010 TPG identified this deletion when reviewing ISPM 5 for the consistency in the use of terms. The following may be considered:

[80] - This term and definition do not have a specific meaning in the IPPC context, and are not needed in the Glossary.

In addition the term is used in ISPM 3:2005 and ISPM 11:2004 with a different meaning.

[81] Proposed for deletion

[82]

competitor	An organism which competes with pests for essential elements (e.g. food, shelter) in the environment [ISPM No. 3, 1996]

[83] ## 3.8 Control point

[84] Background. The October 2010 TPG identified these deletions when reviewing ISPM 5 for the consistency in the use of terms. The following may be considered:

[85] - This term and definition do not have a specific meaning in the IPPC context, and are not needed in the Glossary.

In addition control points are explained in ISPM 14:2002 (*The use of integrated measures in a systems approach for pest risk management*).

[86] Proposed for deletion:

[87]

control point	A step in a system where specific procedures can be applied to achieve a defined effect and can be measured, monitored, controlled and corrected [ISPM No. 14, 2002]

[88] ## 3.9 Dosimeter and dosimetry

[89] Background. The October 2010 TPG identified these deletions when reviewing ISPM 5 for the consistency in the use of terms. The following may be considered:

[90] - These terms and definitions do not have a specific meaning in the IPPC context, and are not needed in the Glossary.

The terms are well-known words of physics and not used in any particular or different way in ISPM 18:2003 and ISPM 28:2007.

[91] Proposed for deletion:

[92]

dosimeter	A device that, when irradiated, exhibits a quantifiable change in some property of the device which can be related to absorbed dose in a given material using appropriate analytical instrumentation and techniques [ISPM No. 18, 2003]
dosimetry	A system used for determining absorbed dose, consisting of dosimeters, measurement instruments and their associated reference standards, and procedures for the system's use [ISPM No. 18, 2003]

[93] ## 3.10 Ionizing radiation

[94] Background. The October 2010 TPG identified this deletion when reviewing ISPM 5 for the consistency in the use of terms. The following points may be considered:

[95] - This is a definition from physics that has no specific meaning for the IPPC, and is not needed in the Glossary.

[96] Proposed for deletion:

[97]

ionizing radiation	Charged particles and electromagnetic waves that as a result of physical interaction create ions by either primary or secondary processes [ISPM No. 18, 2003]

[1] **DRAFT REVISION TO ISPM 5 (*GLOSSARY OF PHYTOSANITARY TERMS*) - SUPPLEMENT NO. 1: GUIDELINES ON THE INTERPRETATION AND APPLICATION OF THE CONCEPT<u>S</u> OF OFFICIAL CONTROL ~~FOR~~<u>IN RELATION TO</u> REGULATED PESTS <u>AND NOT WIDELY DISTRIBUTED IN RELATION TO QUARANTINE PESTS THAT ARE PRESENT IN AN AREA</u>**

[2]

Date of this document	2011-05-10
Document category	Draft revision of Supplement 1 to ISPM 5
Current document stage	Edited and formatted in template of 2010-02. Revised in 2010-03 to incorporate consistency ink amendments noted by CPM-5. Draft for SC 2011-05. SC 2011-05 revised text
Origin	Work programme topic: Not widely distributed (supplement to ISPM No. 5: *Glossary of phytosanitary terms*), ICPM-7 (2005)
Major stages	Specification No. 33, approved SC 2006-05. Reviewed by SC-7 2008-05. Approved for member consultation SC 2011-05.
Notes to this document	For the purpose of visibility of the new text on not widely distributed, and in order to not reopen the discussion on the official control text (as requested by the SC), the text is marked as follows. – original text on official control incorporating the consistency ink amendments noted by CPM-5 in 2010 (as additions or deletions to the original text on official control) — Grey – new text on not widely distributed — <u>black underlined</u> – original text on official control deleted for the purpose of integrating both texts — ~~in black and strikethrough~~. Note that renumbering of sections does not show as changes. Deletions do not intend to change the content of the official control supplement, but some deletion was necessary: for example, essential changes to integrate both texts, updates to current glossary or IPPC terminology (e.g. “phytosanitary import requirements”, “contracting party”), consistency with the structure of recent ISPMs (e.g. sections on adoption, background), updates to ISPM references, editorials. 2011-01-31: Formatting for Editor; 2011-02-12and 2011-03-10: editorial checks; 10 March 2011: Formatting for SC 2011-05. 2011-05-10: editorial checks.

[3] ## Adoption

[4] <u>This supplement was first adopted by the Third Interim Commission on Phytosanitary Measures (2001) as a supplement to ISPM 5:2001, *Supplement No. 1: Guidelines on the interpretation and application of the concept of official control for regulated pests*. The first revision was adopted by the Commission on Phytosanitary Measures in 20-- as the present Supplement No. 1 to ISPM 5.</u>

[5] # INTRODUCTION

[6] ## Scope

[7] This ~~guideline~~supplement ~~refers only to~~ provides guidance on the official control of regulated pests and, for the decision on whether a pest qualifies as a quarantine pest, determination of when a pest is considered to be present but not widely distributed. For the purposes of this ~~guideline~~supplement, the relevant regulated pests are both quarantine pests that are present in an importing country but not widely distributed and regulated non-quarantine pests.

[8] ## References

[9] **ISPM 1**. 2006. *Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade.* Rome, IPPC, FAO.

[10] **ISPM 2**. 2007. *Framework for pest risk analysis.* Rome, IPPC, FAO.

[11] **ISPM 6**. 1997. *Guidelines for surveillance.* Rome, IPPC, FAO.

[12] **ISPM 8**. 1998. *Determination of pest status in an area.* Rome, IPPC, FAO.

[13] **ISPM 11**. 2004. *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms.* Rome, IPPC, FAO.

[14] *Report of the ICPM open-ended working group on official control*, 22–24 March 2000, Bordeaux, France., ~~IPPC Secretariat, FAO,~~ Rome, IPPC, FAO.

[15] ## Definition

[16] Official control is defined as:

[17] The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests.

[18] # ~~Purpose~~ BACKGROUND

[19] The words "present but not widely distributed and being officially controlled" express ~~an~~ essential concepts in the definition of ~~a~~ quarantine pest. According to that definition, a quarantine pest must always be of potential economic importance to an endangered area. In addition, it must either meet the criterion of not being present in that area or it must meet the combined criteria of being not widely distributed and subject to official control.

[20] The *Glossary of phytosanitary terms* defines official as "established, authorized or performed by an NPPO" and control as "suppression, containment or eradication of a pest population". However, for phytosanitary purposes, the concept of *official control* is not adequately expressed by the combination of these two definitions.

[21] The purpose of this guideline is to describe more precisely the interpretation of:

[22] - the concept of official control and its application in practice for quarantine pests that are present in an area as well as for regulated non-quarantine pests, and
- "present but not widely distributed" in relation to official control for quarantine pests.

[23] A national plant protection organization (NPPO) may choose whether or not to officially control a pest that is of potential economic importance and that is present but is not widely distributed, taking into account other relevant factors from pest risk analysis (PRA), for example the costs

and benefits of regulating the specific pest.

[24] **REQUIREMENTS**

[25] **1. General Requirements**

[26] Official control is subject to ISPM 1:2006, in particular the principles of non-discrimination, transparency, equivalence of phytosanitary measures and pest risk analysis.

[27] "Not widely distributed" is a concept referring to a pest's geographic occurrence within an area. Any pest may be categorized as widely distributed in an area, or not widely distributed, or absent. Transient occurrences of pests in an area are not expected to lead to establishment and therefore are not relevant.

[28] In the case of a quarantine pest that is present but not widely distributed, and where appropriate in the case of certain regulated non-quarantine pests, the importing country should define the infested area(s), endangered area(s) and protected area(s). When a pest is considered not widely distributed this means that the pest is limited to parts of the endangered area, i.e. it has reached only a limited part of its potential distribution within the endangered area or has been eradicated from parts of that area. Thus, when a pest is not widely distributed in an area, there are unaffected parts of the area at risk from further introduction or spread. An endangered area need not be continuous but may consist of several distinct parts of any size. In order to justify the statement of a pest being not widely distributed, a description and quantification of the parts of the endangered area at risk should be made available if requested. There is a degree of uncertainty attached to any categorization of distribution. The categorization may also change over time.

[29] The area for which the NPPO is investigating whether or not the pest is widely distributed should be the same as the area for which the economic impact is being analysed and which is considered for official control. The decision that a pest is a quarantine pest, including consideration of its distribution and placing the endangered area under official control, is typically made by an NPPO with respect to an entire country. However, in some instances it may be more appropriate to decide if a pest is a quarantine pest with respect to parts of a country rather than the whole country. In that case, it is the potential economic importance of the pest for those parts that has to be considered in deciding phytosanitary measures. Examples of when this may be appropriate are countries whose territories include one or more islands or other cases where there are natural or artificially created barriers to pest distribution and establishment.

[30] Official control includes:

[31]
- eradication and/or containment in the infested area(s)
- surveillance in the endangered area(s)

restrictions related to the movement into and within the protected area(s) including phytosanitary measures applied at import.

[32] All official control programmes have elements that are mandatory. At minimum, programme evaluation and pest surveillance are required in official control programmes to determine the need for and effect of control to justify phytosanitary measures applied at import for the same purpose. Phytosanitary measures applied at import should be consistent with the principle of non-discrimination (see section 2.1 below).

[33] For quarantine pests, eradication and containment may have an element of suppression. For

regulated non-quarantine pests, suppression may be used to avoid unacceptable economic impact as it applies to the intended use of plants for planting.

[34] **2. Specific Requirements**

[35] **2.1 Non-discrimination**

[36] The principle of non-discrimination between domestic requirements and phytosanitary import requirements is fundamental. In particular, requirements for imports should not be more stringent than the effect of official control in an importing country. There should therefore be consistency between domestic requirements and phytosanitary import requirements for a defined pest:

[37]
- Import requirements should not be more stringent than domestic requirements.
- Domestic and import requirements should be the same or have an equivalent effect.
- Mandatory elements of domestic and import requirements should be the same.
- The intensity of inspection of imported consignments should be the same as equivalent processes in domestic control programmes.
- In the case of non-compliance, the same or equivalent phytosanitary action should be taken on imported consignments as are taken domestically.
- If a tolerance level is applied within a national programme, the same tolerance level should be applied to equivalent imported material. In particular, if no action is taken in the national official control programme because the pest incidence does not exceed the tolerance level concerned, then no action should be taken for an imported consignment if the pest incidence does not exceed that same tolerance level. Compliance with import tolerance levels is generally determined by inspection or testing at entry, whereas compliance with the tolerance level for domestic consignments should be determined at the last point where official control is applied.

[38]

[39] ~~i~~If downgrading or reclassifying is permitted within an ~~national~~official control programme, similar options should be available for imported consignments.

[40] **2.2 Transparency**

[41] Domestic requirements for official control and the phytosanitary import requirements should be documented and made available, on request.

[42] **2.3 Technical justification**

[43] Domestic requirements and phytosanitary import requirements should be technically justified and result in non-discriminatory phytosanitary measures.

[44] **2.4 Pest risk analysis**

[45] Application of the definition of a quarantine pest requires knowledge of potential economic importance, potential distribution and official control (ISPM 2:2007). The categorization of a pest as present and widely distributed or present but not widely distributed is determined in relation to its potential distribution. This potential distribution represents the areas where the pest could become established if given the opportunity, i.e. its hosts are present and environmental factors such as climate and soil are favourable. ISPM 11:2004 provides guidance on the factors to be considered in assessing the probability of establishment and spread. In the case of a pest that is present but not widely distributed, the assessment of potential economic importance should relate to the areas where the pest is not established.

[46] **2.5 Enforcement**

[47] The domestic enforcement of official control programmes should be equivalent to the enforcement of phytosanitary import requirements. Enforcement should include:

[48]
- a legal basis
- operational implementation
- evaluation and review

phytosanitary action in the case of non-compliance.

[49] ### 2.6 Mandatory nature of official control

[50] Official control is mandatory in the sense that all persons involved are legally bound to perform the actions required. The scope of official control programmes for quarantine pests is completely mandatory (e.g. procedures for eradication campaigns), whereas the scope for regulated non-quarantine pests is mandatory only in certain circumstances (e.g. official certification programmes).

[51] ### 2.7 Area of application

[52] An official control programme can be applied at national, subnational or local area level. The area of application of official control measures should be specified. Any phytosanitary import requirements should have the same effect as the domestic requirements for official control.

[53] Surveillance should be used to determine the distribution of a pest in an area and whether it is not widely distributed.

[54] ISPM 6:1997 describes the components of survey and monitoring systems, and includes provisions on transparency. Biological factors such as pest life cycle, means of dispersal and rate of reproduction may influence the design of surveillance programmes, the interpretation of survey data and the level of confidence in the categorization of a pest as not widely distributed. The distribution of a pest in an area is not a static condition. Changing conditions or new information may necessitate a review of whether a pest is not widely distributed.

[55] "Not widely distributed" is not a description of pest status listed in ISPM 8:1998. Rather it encompasses a number of pest situations described therein. Depending on its distribution relative to the endangered area, the status of a pest that is not widely distributed may be described using one or more of the examples provided in ISPM 8:1998.

[56] ### 2.8 NPPO authority and involvement in official control

[57] Official control should:

[58]
- be established or recognized by the contracting party or the NPPO under appropriate legislative authority
- be performed, managed, supervised or, at minimum, audited/reviewed by the NPPO
- have enforcement assured by the contracting party or the NPPO

be modified, terminated or lose official recognition by the contracting party or the NPPO.

[59] Responsibility and accountability for official control programmes rests with the contracting party. Agencies other than the NPPO may be responsible for aspects of official control programmes, and certain aspects of official control programmes may be the responsibility of subnational authorities or the private sector. The NPPO should be fully aware of all aspects of official control programmes in its country.