SCIENTIFIC OPINION

Scientific Opinion on a composting method proposed by Portugal as a heat treatment to eliminate pine wood nematode from the bark of pine trees[1]

EFSA Panel on Plant Health (PLH)[2, 3]

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ABSTRACT

Following a request from the European Commission, the Panel on Plant Health was asked to deliver a scientific opinion on the appropriateness of a composting method proposed by Portugal as a heat treatment to eliminate pine wood nematode (PWN), *Bursaphelenchus xylophilus* (Steiner and Buhrer) Nickle from bark of pine trees. The Panel evaluated the dossier entitled "Technical requirements for heat treatment of isolated bark of conifers" submitted by the Portuguese Authorities and concluded that a) the process is not adequately described and information on a number of key aspects is not provided, b) the heat treatment protocol does not allow for a full characterisation of the temperature profile within each treated lot, c) the treatment process described does not provide evidence that all the bark particles within the lot achieve a continuous core temperature of 56 °C for 30 minutes and d) insufficient evidence on the sampling methodology is provided to determine the reliability of the testing method provided by the Portuguese document to determine freedom from PWN. Although there is potential for development of a composting method as a heat treatment to eliminate PWN from bark of pine trees, the technical requirements presented in the Portuguese dossier do not adequately demonstrate the effectiveness and reliability of the proposed composting method as a treatment to ensure freedom of treated pine bark from live PWN.

KEY WORDS

Bark, *Bursaphelenchus xylophilus*, composting, heat treatment, pine wood nematode, Portugal

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SUMMARY

Following a request from the European Commission, the Panel on Plant Health was asked to deliver a scientific opinion on the appropriateness of a composting method proposed by Portugal as a heat treatment to eliminate pine wood nematode from bark of pine trees.

The pine wood nematode (PWN), *Bursaphelenchus xylophilus* (Steiner and Buhrer) Nickle, is listed in Community plant health legislation as a harmful organism. Continental Portugal is a demarcated area for PWN and protective measures under Commission Decision 2006/133/EC require achievement of a minimum core temperature of 56 °C for 30 minutes in order to ensure freedom of treated pine bark from live PWN, for movements of susceptible bark from a demarcated area.

The Portuguese Authorities requested recognition of a composting method as a heat treatment against PWN in bark of pine trees, for compliance with Commission Decision 2006/133/EC which requires achievement of a minimum core temperature of 56 °C for 30 minutes in order to ensure freedom from live PWN.

The Panel evaluated the dossier entitled "Technical requirements for heat treatment of isolated bark of conifers" submitted by the Portuguese Authorities. It considered Standard PM 3/53(1) of the European and Mediterranean Plant Protection Organisation and Chapter 3 of the EU-funded research project "New quarantine treatments for horticultural and timber products as alternatives to methyl bromide fumigation", FAIR project CT 984259 (2003), which pertains to composting of bark and wood chips, and additional scientific literature relevant to the evaluation.

The Panel concluded that:

- The process is not adequately described and information is not provided on a number of key aspects relating to the size and specification of the lot (e.g. particle size, moisture content) and monitoring of the treatment;
- Information is not provided to enable an accurate characterisation of the temperature profile within each treated lot;
- The treatment process as described does not provide evidence that a minimum temperature of 56 °C for 30 minutes has been achieved throughout the bark;
- The dossier provides insufficient evidence on the sampling methodology and there is a high level of uncertainty on the reliability of the testing method in determining freedom from PWN.

Although there is potential for development of a composting method as a heat treatment to eliminate PWN from bark of pine trees, the technical requirements presented in the Portuguese dossier do not adequately demonstrate that the proposed composting method is in compliance with Commission Decision 2006/133/EC requiring achievement of a minimum core temperature of 56 °C for 30 minutes to ensure freedom from live PWN.

The Panel concluded that the evidence presented on the proposed composting method is insufficient to ensure freedom of treated pine bark from live PWN, as required by Decision 2006/133/EC for movements of susceptible bark from a demarcated area.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

Continental Portugal is a demarcated area for pine wood nematode (PWN). Commission Decision 2006/133/EC requires that isolated bark shall not be allowed to leave the demarcated area except where it is accompanied by a plant passport, after having undergone an appropriate heat treatment to achieve a minimum core temperature of 56 °C for 30 minutes in order to ensure freedom from live PWN. Portugal has implemented this provision in the form of a composting treatment. Following a request of the Commission to provide the validation study based on which the decision was taken that the composting treatment is a reliable instrument to comply with the relevant provisions of Decision 2006/133/EC, the Portuguese Authorities on 27 April 2010 submitted a dossier consisting of a treatment protocol (Annex II) and EPPO Standard PM 3/53(1): Fermenting (composting) of bark of conifers (Annex III), which was used as a basis of reference for developing the protocol.

In view of the trade volume of pine bark from Portugal to other Member States and past interceptions of live PWN on treated pine bark, an assessment of the reliability of the composting method proposed by the Portuguese Authorities is critical to appropriately manage the risk of spread of PWN outside of the demarcated area. A scientific opinion from EFSA is therefore requested.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

EFSA is requested, pursuant to Article 29(1) and Article 22(5) of Regulation (EC) No 178/2002, to provide a scientific opinion concerning the effectiveness and the reliability of a composting method, proposed by the Portuguese Authorities as a heat treatment against pine wood nematode (PWN), *Bursaphelenchus xylophilus*, in bark of pine trees, for compliance with Commission Decision 2006/133/EC which requires achievement of a minimum core temperature of 56 °C for 30 minutes in order to ensure freedom from live PWN.

In particular, EFSA is requested to determine whether the composting method enclosed in the protocol (Annex II), based on EPPO Standard 3/53(1) (Annex III), can be considered to ensure freedom of treated pine bark from live PWN, as required by Decision 2006/133/EC for movements of susceptible bark from a demarcated area.

ASSESSMENT

1. Introduction

This document presents the opinion of the Panel on Plant Health concerning the effectiveness and the reliability of a composting method proposed by the Portuguese Authorities as a heat treatment for eliminating pine wood nematode (PWN), *Bursaphelenchus xylophilus*, from bark of pine trees.

1.1. Heat treatment for pine wood nematode

Bursaphelenchus xylophilus (Steiner and Buhrer) Nickle, the pine wood nematode (PWN), is listed as a harmful organism in Community plant health legislation and protective measures are taken to prevent the introduction and further spread in the EU. Commission Decision 2006/133/EC requires additional measures against the dissemination of PWN in Portugal, following its introduction in Portugal in 1999. It is required within demarcated areas that susceptible bark shall be heat-treated in such a way that a minimum temperature of 56 °C for 30 minutes has been achieved throughout the bark. This requirement is based on the heat treatment outlined in ISPM No. 15 (FAO, 2009), which specifies a minimum wood core temperature of 56 °C for 30 continuous minutes. Various methods or processes may achieve these parameters including kiln-drying, heat-enabled chemical pressure impregnation, microwave or other treatments if they meet the heat treatment parameters specified in this standard.

1.2. Evaluation methodology

The Panel evaluated the dossier entitled "Technical requirements for heat treatment of isolated bark of conifers" submitted by the Portuguese Authorities with reference to the following:

a) Standard PM 3/53(1) of the European and Mediterranean Plant Protection Organisation (EPPO);

b) Chapter 3 of the EU-funded research project "New quarantine treatments for horticultural and timber products as alternatives to methyl bromide fumigation", FAIR project CT 984259 (2003), which pertains to composting of bark and wood chips;

c) Additional scientific literature as relevant, including the studies by Solbraa (1979a,b,c,d) referenced within the EPPO Standard PM 3/53.

1.3. Scope of the opinion

The technical requirements submitted by the Portuguese Authorities relate to heat treatment of isolated bark of conifers. The terms of reference of the request refer to bark of pine trees. For the purposes of the opinion the term "bark" refers to susceptible bark in line with Commission Decision 2006/133/EC.

Recommendations for composting of bark of conifers are outlined in the EPPO Phytosanitary Procedure PM 3/53(1), "Fermenting (composting) of bark of conifers" which makes reference to studies of composting of bark carried out by Solbraa (1979a, b, c, d). However, the Panel notes that recommendations in this Standard do not relate to PWN but to the fungi *Atropellis* spp., non-European *Cronartium* (including *Endocronartium* spp. and *Peridermium* spp.) and *Inonotus weirii*, and the insects Scolytidae (non-European) and *Ips amitinus*.

The scope of the opinion is restricted to evaluation of the technical requirements submitted by the Portuguese Authorities and no evaluation is made of the method outlined in the EPPO Standard or of alternative composting methods or processes.

2. Evaluation

2.1. General comments on the dossier

The Panel considers that

- The technical requirements in the Potuguese dossier do not adequately demonstrate that the proposed composting method achieves a minimum core temperature of the bark particles of 56 °C for 30 minutes, as required by ISPM 15 and Commission Decision 2006/133/EC;

- The process is not adequately described in the Portuguese document. Information on a number of aspects is not provided as detailed in section 2.2 below.

2.2. Specific comments

2.2.1. Formation and identification of the lot

The Panel considers that formation and identification of the lot is inadequately described. Only the shape and the maximum height of the lot are described in the Portuguese document ("prismatic of trapezoidal sections and height which should be uniform and must not exceed four meters").

No information is provided on the following aspects outlined in the method described in the EPPO Standard PM 3/53(1) "Fermenting (composting) of bark of conifers":

- Size of lot (only the maximum height of 4 m is given, with no information about minimum dimensions);

- Particle size (range);

- Bark characteristics (moisture content, pH, C:N).

The EPPO Standard PM 3/53(1) recommends a minimum size of bark stacked in lots of not less than 4 t.

The particle size and bark characteristics can potentially influence the composting process and thus the effectiveness and reliability of the heat treatment proposed. Smaller particles have more surface area available for microbial activity. Reducing the particle size of bark can increase the effectiveness of the composting process and it is recommended in EPPO Standard PM 3/53(1) "Fermenting (composting) of bark of conifers" that 95 % of particles fall within the size range 5-50mm. However, the Panel notes some uncertainty as the particle size was not found to be an important factor influencing thermophilic[4] activity in the FAIR project (CT98 4259),although only small scale experiments were carried out and larger scale studies are recommended to verify the results.

Composting is reported as proceeding best at a moisture content of 40-60 % by weight (Cornell Composting, Science and Engineering: http://compost.css.cornell.edu/monitor/monitormoisture.html);

[4] Thermophilic composting is a process based on the activity of micro-organisms growing best at temperatures above 40 °C

Solbraa,1979c). A moisture content of 150-230 % of oven dry weight (~60-70 %) is recommended in EPPO Standard. Moisture content is an important factor which may influence the potential for PWN to actively migrate to avoid areas of high temperature within the compost. PWN is a vigorous nematode that may move 150 cm/day in trees (Kuroda 2008) and 10 cm over dry bark (Arakawa and Togashi 2002). As nematodes normally move over surfaces in water films, a moisture content of 40-70 % will not prevent PWN from migrating within the heap to avoid areas of high temperature.

A pH value of between 5.4 and 9 is recommended in EPPO Standard PM 3/53(1) as pH may influence the effectiveness of the composting process. During composting the decomposition of organic material is carried out by a succession of microorganisms with different pH optima. During composting changes in the environmental conditions including pH value affect microbial succession and activity (EPA,1994).

Carbon (C) and nitrogen (N) are the most important nutrients needed for microbial decomposition, and thus the C:N ratio has a strong influence on the decomposition rate in the compost heap. Additives may be used to achieve an optimum ratio of between 20:1 and 30:1 (Solbraa, 1979). Insufficient nitrogen for optimal growth of the microbial populations reduces the efficiency of the composting process and result in the temperature of the compost remaining relatively low. Wood and bark contain hemicelluloses and celluloses which break down readily, but the decomposition of phenolic compounds and polymers is more difficult, releasing terpenes and tannins. The presence of secondary compounds, such as terpenes and tannins, also inhibits the activity of micro-organisms involved in composting and older bark is likely to have a diminished inhibitory effect (Mathur, 1991). Therefore further specification of the source material including the age of bark would also be desirable.

2.2.2. Monitoring of treatment

2.2.2.1. Temperature probes and automatic registration

According to the Portuguese document, six probes are recommended to be distributed evenly in the lot and buried to a depth of 1.20 m for a heap of up to 600 m^3 bark, and an additional probe is added for each increment of 300 m^3. The probes have to be connected to equipment that allows the automatic recording of readings taken during the treatment. The records must include the day, time, and lot number of treatment.

The placement of probes is not clearly defined in the Portuguese document. The Panel considers that distribution of probes should be described more precisely and that temperatures should be measured at different depths (including bottom, middle and upper zone of the lot) and not at only at one depth (1.2 m) as proposed. Due to the acknowledged heterogeneity of bark heaps and, in the absence of studies to verify mortality of PWN within the bark heap, a greater number of temperature probes would enable more accurate characterisation of the temperature profile within the lot.

The Panel further notes that the Portuguese monitoring system measures the temperatures between bark particles but not within bark particles, and does not verify that the core of the bark particles reaches the required temperature as stated in ISPM 15 (FAO, 2009).

2.2.2.2. Treatment process

A process is described in the Portuguese document whereby following the recording of 58 °C in the upper layer (1.5 m) for six consecutive hours the lot is turned. It is further turned a second time when a temperature of 60 °C is recorded for six consecutive hours.

The Panel considers that the treatment process in the Portuguese document does not sufficiently describe the technical details of the process e.g. aeration and turning process. No information is given on additives which could influence the decomposition process of the bark (Solbraa, 1979b).

Compost temperatures exceeding 60 °C can be achieved in a range of composting systems. Temperature-time combinations and other sanitising factors of composting on 64 plant pathogen and nematode species have been reviewed by Noble and Roberts (2004). However, no information is available specifically on PWN. During the composting process oxygen is used up quickly by the microorganisms as they metabolize the organic matter in the thermophilic (first) phase. As the oxygen becomes depleted the composting process slows and temperatures decline. Aerating the compost by turning facilitates supply of oxygen and thus, the turning process is considered a key component (Solbraa 1979c, FAIR CT98 4259 Annex 2: Report on placement of F. Reay-Jones to Forest Research, 2002). The EPPO Standard PM 3/53(1) recommends the stack is turned 3-4 times depending on the moisture and oxygen content.

A high level of variability of microbial activity and of the consequent temperature profiles in the treated bark heaps can be recorded during the composting process. Spontaneous thermophilic activity within the bark stack can be achieved, but the results of FAIR project indicate that less than half of those which exhibited thermophilic activity achieved the desired temperature of 56 °C.

The Panel considers that the treatment process and method for turning and ensuring effective heat treatment throughout the lot is not adequately described in the Portuguese document. In particular, the turning process should be further elaborated to demonstrate that the cool (middle and lower) zones from the first phase are placed in the thermophilic zones in the second and subsequent phases. There is a high level of uncertainty that the lethal temperature for PWN will be reached throughout the lot particularly in lower zones of the bark. As an optimum temperature for PWN of 35-40 °C is demonstrated in pine chip piles (Dwinell, 1986), the proposed process described in the Portuguese document, may support a considerable reproduction of PWN rather than to ensure its eradication.

2.2.2.3. Testing

The Portuguese document states that two composite samples per 500 m^3, or part, of treated bark should be collected and that collection of bark samples should be made by the official inspector responsible for monitoring the treatment.

The Panel considers that the sampling procedure should be described in more detail to outline more clearly each step of the procedure (including the number of subsamples/cores, sampling equipment, number of sampling locations, depth of sampling, volume of subsamples/composite samples, preparation of samples, extraction procedure and procedures for nematode identification) to enable the reliability of the testing method for detection of PWN to be assessed.

In view of the uncertainty concerning the temperature profile throughout the lot, the Panel considers that the information provided, and in particular the number of composite samples (Christensen et al., 2000), are insufficient to verify freedom from PWN.

CONCLUSIONS

From an analysis of the submitted document and additional evidence relevant to the assessment, the Panel concluded that:

- The process is not adequately described and information is not provided on a number of key aspects relating to the size and specification of the lot (e.g. particle size, moisture content) and monitoring of the treatment;

- Information is not provided to enable an accurate characterisation of the temperature profile within each treated lot;

- The treatment process, as described, does not provide evidence that a minimum temperature of 56 °C for 30 minutes has been achieved throughout the bark;

- The dossier provides insufficient evidence on the sampling methodology and there is a high level of uncertainty on the reliability of the testing method in determining freedom from PWN.

Although there is potential for development of a composting method as a heat treatment to eliminate PWN from bark of pine trees, the technical requirements presented in the Portuguese dossier do not adequately demonstrate that the proposed composting method is in compliance with Commission Decision 2006/133/EC requiring achievement of a minimum core temperature of 56 °C for 30 minutes to ensure freedom from live PWN.

The Panel concluded that the evidence presented on the proposed composting method is insufficient to ensure freedom of treated pine bark from live PWN, as required by Decision 2006/133/EC for movements of susceptible bark from a demarcated area.

DOCUMENTATION PROVIDED TO EFSA

1. Letter, 30 June 2010. Submitted by the European Commission, ref. SANCO.E1/RB/adr (2010) 416455 with annexes:

    a. Annex I: Background and Terms of Reference

    b. Annex II: Technical requirements for heat treatment of isolated bark and conifers. Version 3 (26/04/10). Directorate-General for Agriculture and Rural Development, Portugal

    c. Annex III: Fermenting (composting) of bark of conifers, Standard PM 3/53(1), European and Mediterranean Plant Protection Organisation

2. Report of EU-funded research project by K.F.A. Walters & H. Evans (2003), New quarantine treatments for horticultural and timber products as alternatives to methyl bromide fumigation, FAIR project CT 984259), of which chapter 3 pertains to composting of bark and wood chips.

REFERENCES

Arakawa, Y. and Togashi, K. 2002. Newly discovered transmission pathway of *Bursaphelenchus xylophilus* from males of the beetle *Monochamus alternates* to *Pinus densiflora* trees via oviposition wounds. Journal of Nematology 34: 396-404

Christensen KK, Kron E and Carlsbæk M, 2000. Sanitary aspects of composting biodegradable waste – Towards a Nordic evaluation model. TemaNord 2000:512. Nordic Council of Ministers, Copenhagen, Denmark. 73 pp.

Cornell Waste Management Institute, 1996. Monitoring compost moisture. Available from: http://compost.css.cornell.edu/monitor/monitormoisture.html

Dwinell LD, 1986. Ecology of the pinewood nematode in Southern pine chip piles. Res. Pap. SE-258. Asheville, N.C., U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 14 pp.

EPA, 1994. Composting of yard, trimmings and municipal solid waste, US Environmental Protection Agency. 141 pp.

FAO (Food and Agriculture Organisation of the United Nations), 2009. International standards for phytosanitary measures 1 to 16 (2009), Revision of ISPM No. 15 "Regulation of wood package material in international trade." FAO. Available from: https://www.ippc.int/file_uploaded/1240490152156_ISPM_15_Revised_2009_E.pdf

Kuroda K. 2008. Physiological incidences related to symptom development and wilting mechanism. In: Zhao BG, Futai K, Sutherland JR, & Takeuchi Y. (Eds.) Pine Wilt Disease. Springer: 204-222.

Mathur SP. 1991. Composting Processes. In AM Martin (Ed.) Bioconversion of Waste Materials to Industrial Products. Elsevier, London, New York. P 147-186

Noble R and Roberts SJ, 2004. Eradication of plant pathogens and nematodes during composting: a review. Plant Pathology, 53, 548-568.

Solbraa K, 1979a. Composting of bark I. Different bark qualities and their uses in plant production. Meddelelser fra Norsk Institutt for Skogforskning, 34, 281-333.

Solbraa K, 1979b. Composting of bark II. Laboratory experiments. Meddelelser fra Norsk Institutt for Skogforskning, 34, 335-386.

Solbraa K, 1979c. Composting of bark III. Experiments on a semi-practical scale. Meddelelser fra Norsk Institutt for Skogforskning, 34, 387-439.

Solbraa K, 1979d. Composting of bark. IV. Potential growth-reducing compounds and elements in bark. Meddelelser fra Norsk Institutt for Skogforskning, 34, 443-508.

Walters KFA and Evans H, 2003. New quarantine treatments for horticultural and timber products as alternatives to methyl bromide fumigation, FAIR project CT 984259.