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# Coniferous bark hot steam treatment for the elimination of the pinewood nematode

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## ABSTRACT

In order to develop an artificial heat treatment to eliminate the pinewood nematode (PWN), *Bursaphelenchus xylophilus*, from coniferous bark, an industrial equipment, based on hot steam was build up which enables continuous bark treatment for more than 30 min with temperatures above 80°C. Biological assays were performed using experimental units (bags) with *Pinus pinaster* bark and wood chips containing more than 100 000 PWN (60% third dispersal juvenile stage). The bags were heat treated for 30 min and the temperature inside monitored by temperature probes. The total number of live nematodes was quantified immediately after treatment and after incubation (25°C for 15 days) and in both situations no nematodes were detected revealing efficacy in eliminating PWN from coniferous bark.

## INTRODUCTION

The Food and Agriculture Organization of the United Nations, through the International Plant Protection Convention, adopted the International Standard for Phytosanitary Measures No. 15 (ISPM N° 15) which defines guidelines for the pinewood nematode (PWN), *Bursaphelenchus xylophilus*, elimination from wood products by heat treatment with a minimum temperature of 56°C for 30 min (FAO, 2009). Since November 2012, pine bark that is traded from Portugal to other countries has to be heat treated by hot steam. This treatment is being used in six Portuguese companies and enables continuous bark treatment for more than 30 min with temperatures above 80°C. The hot steam treatment is performed in industrial equipment composed by a bark feeder tank, a bark

inlet, a steam injection chamber and a heat storage chamber monitored by several temperature probes which permit real-time recording and storage of temperature data. In the present study, we have evaluated the efficacy of the hot steam treatment to eliminate PWN.

## MATERIALS AND METHODS

In order to evaluate the efficacy of the hot steam treatment to eliminate PWN, biological assays were performed using six experimental units (bags) with bark and wood chips, from PWN infected *Pinus pinaster* trees, containing more than 100 000 PWN (60% third dispersal juvenile stage) (Magnusson & Schröder 2009). Temperature probes were introduced in each bag. Then, the bags were placed into the hot steam equipment together with bark and heat treated for at least 30 min. The number of nematodes, present in each bag was estimated before and after the treatment using the tray method (Whitehead & Hemming 1965). After the treatment, the bags were recovered. In three of them, the number of live nematodes was quantified immediately and the other three were incubated at 25°C for 15 days to allow any live nematode present to breed and maximise the likelihood of detection (EPPO 2013). After the incubation period, the number of live nematodes was also quantified.

## RESULTS

The temperature inside the bags exceeded the recommended by the ISPM N°15 being higher than 80°C. In both situations, after treatment and after incubation period, no nematodes were detected. The results confirmed that the continuous hot steam system goes beyond the ISPM N°15 and revealed effective in eliminating PWN from coniferous bark.

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