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Effect of methyl bromide on *Bursaphelenchus xylophilus* in pine wood

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One of the unintended consequences of the globalization of trade has been an increase in the frequency of introductions and the numbers of exotic species intercepted at ports of entry. This is largely due to the increase in volume of trade and a broadening of trading partners, especially with the Pacific Rim and Asia. During the years 1985 through 1998, the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) made 6,952 interceptions of exotic pests on wood articles at nearly all of 100 port locations throughout the United States. The intercepted insects originated from at least 95 countries worldwide. A global strategy needs to address the exotic pest problems. Whether dealing with the export or import of transported wood, the pest control principles would be quite similar.

Since 1986, research on decontaminating softwood chips, green lumber, and logs concentrated on the pinewood nematode, *Bursaphelenchus xylophilus* (PWN), and its *Monochamus* vectors. The PWN, which is native to North America, is a destructive pest of the pine forests of Japan and China. The nematode has also been introduced into Taiwan, South Korea, and Portugal. On January 1, 2000, China put into place regulations to ensure that solid wood packing material (dunnage, crating, packing cases, pallets, et al.)(SWPM) entering their country was not infested by the PWN. Recent interceptions of the PWN in SWPM by the Finnish Plant Quarantine Service have resulted in emergency legislation by Finland. Although the use of elevated temperatures (56°C for 30 minutes) to eradicate the PWN and its *Monochamus* vectors in SWPM is the preferred mitigation method, there are circumstances when fumigation with methyl bromide is the most feasible and cost effective method available. Pre-shipment and quarantine uses, which are allowed under the Montreal protocol, would be an interim solution for countries without the resources or facilities to use heat pasteurization to decontaminate SWPM without seriously disrupting trade.

Methods and materials

In early June 2000, three shortleaf pines (*Pinus echinata*) were felled and their main stems were then sawn into 91-102-cm-long logs. The logs were left in the forest where they were subsequently colonized by pine sawyers (*Monochamus* spp.), vectors of the pinewood nematode. In early August, the logs were sawn into disks, cants, or boards. The disks were 1-, 2-, 3- and 6-cm in thickness and had a mean diameter of 19 cm. The cants were 12.7 x 12.7 x 96.5 cm. The boards were 2.5 x 10.2 x 91 cm and 5.0 x 10.2 x 91 cm.

The disks, cants and boards were divided into three treatment group. Each load or replicate consisted of one each of the four disk sizes, a cant, nine 2.5 x 10.2 x 91 cm boards, and nine 5.0 x 10.2 x 91 cm boards. Before and after fumigation, the disks, cants, and boards were sampled for the PWN by drilling three 2.5 cm deep holes with an auger bit. After fumigation, the cants were also sampled at 2.5-5.0-cm depth. The borings within a disk, cant or board were pooled and the Baermann funnel procedure was used to extract the nematodes (Dwinell et al. 1994). The

presence or absence of the PWN in the samples were recorded.

The fumigation was done in three chambers constructed of plastic pipes and covered with a polyethylene sheet. The chambers, each of which had a volume of 2.83 m^3, were on a concrete pad. The edges of the cover were sealed with dirt prior to fumigation. The air temperature in the chambers during fumigation was recorded using Hobo data loggers (Onset Computer Corporation). The three fumigation treatments were 0, 0.45, and 0.90 kg methyl bromide/2.83 m^3 and the treatment duration was 24 hours. There were three replicates of each treatment.

Results and discussion

Prior to fumigation, the PWN was extracted from all the disks, cants, and boards (Table 1). The PWN was not extracted from any of the disks, cants or boards which had been fumigated, regardless of rate. The PWN was extracted from the control treatment disks, cants, and boards. The temperature during fumigation averaged 46.2°C for the three chambers, and the mean maximum temperature was 56.6°C. High temperatures during fumigation probably contributed to the penetration and efficacy of methyl bromide. The data is consistent with earlier reports on using methyl bromide to eradicate the PWN in in pine wood. For example, in 1994, I reported that methyl bromide at the rate of 240 g/m^3 would eradicate the PWN in small logs of eastern (*P. stobus*), slash (*P. elliottii* var. *elliottii*), and loblolly (*P. taeda*) pines. Wang et al. (1995) reported that the efficacy of methyl bromide to eliminate the PWN in logs was dependent on temperature, dosage, duration of fumigation, the wood size, moisture content of the wood, and the position of the wood in the stack. Methyl bromide, as a pre-shipment or quarantine use, shows promise as an interim or emergency treatment for decontaminating SWPM.

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Table 1. The effect of methyl bromide fumigation on *Bursaphelenchus xylophilus* (PWN) in pine disks, cants, and green lumber

	Methyl bromide (kg/2.83m^3)					
	-0-		0.45		0.90	
Pine wood Dimensions	Number samples with PWN/total number of samples before and after fumigation[a]					
	Pre-	Post-	Pre-	Post-	Pre-	Post-
2.5 cm disk[b]	3/3	3/3	3/3	0/3	3/3	0/3
5.0 cm disk[b]	3/3	3/3	3/3	0/3	3/3	0/3
7.5 cm disk[b]	3/3	3/3	3/3	0/3	3/3	0/3
15.2 cm disk[b]	3/3	3/3	3/3	0/3	3/3	0/3
12.7 cm x 12.7 cm cant[c]	3/3	3/3	3/3	0/3	3/3	0/3
2.5 cm x 10.1 cm board[d]	9/9	9/9	9/9	0/9	9/9	0/9
5.0 cm x 10.1cm board[d]	9/9	9/9	9/9	0/9	9/9	0/9
TOTALS	**33/33**	**33/33**	**33/33**	**0/33**	**33/33**	**0/33**

[a] Each treatment combination was replicated three times.
[b]. Disk thickness; the disks had a mean diameter of 19 cm.
[c] The cants had a mean length of 96.5 cm. After fumigation, the cants were sampled at 2.54 cm and 5.0 cm depths.
[d] The boards had a mean length of 91 cm.

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