CONFIRMATION OF PROPOSED SULFURYL FLUORIDE QUARANTINE DOSAGES FOR PINEWOOD NEMATODE CONTROL

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The pinewood nematode (PWN) (*Bursaphelenchus xylophilus* Steiner and Buhrer, 1934 Nickle, 1970), the causal agent of pine wilt disease, has been intercepted in pine chips, unseasoned pine lumber, and wood packing material (WPM). Likewise, the PWN's insect vectors, *Monochamus* spp. (Coleoptera: Cerambycidae), have been found in pallets, crates and dunnage. The PWN, which is native to North America, is transmitted to recently killed conifers or freshly felled logs during egg-laying of the insect vector (aka "secondary transmission"). It is through secondary transmission that the PWN gets into the wood transport system.

Several countries now regulate the import of all coniferous chips, logs, sawn wood, and WPM to protect their forests from the PWN and other exotic pests. Although methyl bromide can be used for quarantine purposes under the Montreal Protocol, there is interest internationally in finding an alternative fumigant for wood packing material. Sulfuryl fluoride (SF) could serve as an alternative for methyl bromide for managing the PWN and its insect vectors in unseasoned pine wood. Previous research by Dwinell, Thoms, and Prabhakaran developed proposed quarantine doses using SF for PWN at temperatures of 15°C and higher. The report includes additional research to validate quarantine doses of SF at 20° and 25°C for control of PWN.

PWN extracted from laboratory cultures augmented those in wood sticks (2.5 x 2.5 x 20 cm) sawn from PWN-infested logs. Fumigations using commercial grade sulfuryl fluoride (99.8%; Dow AgroSciences, Indianapolis, IN) were conducted in 10-L glass chambers placed in a 4.8-m-long refrigerated cargo container. Three target CT dosages (g-h/m^3); the theoretical dose and two doses representing the theoretical dose ± 4 g/m^3, were evaluated for each temperature for 24 h exposure. Each fumigant dosage and untreated control treatment was replicated two times per temperature, with 10 wood sticks per replicate.

SF was injected with a gas-tight syringe into each chamber through special fittings after first withdrawing sufficient air to avoid possible loss of gas during injection. SF concentrations in fumigated and untreated control chambers were measured at 1, 2, 4, and 24 h post-fumigant introduction using a SapphIRe IR analyzer (Thermo-Fisher Scientific, Franklin, MA), modified to contain a closed loop system. At 20°C, the accumulated CT dosages ranged from

1947-2287 g-h/m^3 for the 24 h exposure; the proposed quarantine dosage 20°C is 2100 g-h/m^3. At 25°C, the accumulated CT dosages ranged from 1342-1586 g-h/m^3 for the 24 h exposure; the proposed quarantine dosage for 25°C is 1500 g-h/m^3.

The wood moisture content (WMC), expressed on a dry weight basis, was determined by drying a second set of 30 randomly selected control wood sticks. The mean WMC of wood sticks was 58.7%, indicating wood was saturated with water to ensure maximum survival of PWN and a worse-case scenario for fumigant penetration.

After exposure and aeration, wood sticks were separated by treatment and replicate, and assayed using the Baermann funnel method. The number and life stage (adult or juvenile) of nematodes occurring in each extraction sample were determined at 7 and 21 d after initiation of extraction. At 7 d and 21 d post-fumigation, high numbers of PWN (4300 and 924 total) were extracted from untreated controls at 20°C and 25°C.

At 20°C, no PWN were extracted at the highest SF CT dosages of 2183 and 2287 g-h/m^3 through 21 d post-fumigation. PWN were extracted at the four lower CT dosages including a CT dosage 43 g-h/m^3 above the proposed quarantine CT dosage for 20°C. This difference could be due to the higher mean WMC (59%) of sticks in these trials compared to lowest mean WMC (37%) of sticks in previous laboratory chamber fumigations used to derive the quarantine CT dosage rates for 20°C. SF has low solubility in water, 0.075% by weight. Therefore, the proposed quarantine dosage for 20-24.9°C is increased by 200 g-h/m^3 to 2300 g-h/m^3.

At 25°C, no PWN were extracted from sticks in five of the six fumigation treatments. Two PWN juveniles were extracted from one treatment (1342 g-h/m^3) which was 158 g-h/m^3 less than the proposed quarantine CT dosage of 1500 g-h/m^3. These trials confirm that the proposed quarantine dosages at 25-29.9°C are effective and no changes are proposed.