Fumigation of SWPM as a Quarantine Treatment for *Anoplophora glabripennis*.

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The Asian longhorned beetle, *Anoplophora glabripennis* Motsch. (=*Malanauster nobilis* Ganglbauer)(ALB) (Coleoptera: Cerambycidae) has been introduced into two US metropolitan areas, probably through infested solid wood packing or dunnage from China. Fumigations with sulfuryl fluoride (SF) and methyl bromide (MB) of solid wood timbers infested with Asian longhorned beetle, Anoplophora glabripennis (ALB) were conducted in Lanzhou, PRC during 2001-02. These fumigations were conducted to confirm the efficacy of the USDA, APHIS, PPQ Treatment Schedule T404-b-1-1 for methyl bromide and to evaluate SF as a possible alternative to MB for ALB and other wood boring insects.

All fumigations consisted of infested *Populus* spp. timbers (10 x 10 x 115 cm) sawn from naturally infested logs obtained locally near Lanzhou, Gansu Province, PRC. Fumigations were conducted in 432-l Lexan® chambers (0.6 m x 0.6 m by 1.2 m long) held within refrigerated, 20-ft (6.1 m) containers. Each fumigation replicate consisted of 12 timbers, with a loading factor of about 27-30 %. Wood moisture contents were typically 40-50% wet basis. Each replicate contained typically 150-250 larvae, plus other wood boring species of Lepidoptera. Following 24 or 48 hour fumigations, the wood was held for 4-5 days for MB and 7-14 days for SF before hand-splitting to evaluate mortality. Control mortality was typically 1-3% or less. Larvae were considered alive if mandibular movement was observed. Complications included the evolution of CO_2 and VOCs by wood in the chambers. The CO_2 needed to be monitored separately with SF fumigations, and Ascarite to scrub CO_2 was required during MB fumigation.

With 5-replicate fumigations with about 1,000-1,250 larvae each, the schedule T404-b-1-1 for MB was 100% successful at 4.4°C (80 mg/l) and at 21.1°C (48 g/m3). New, intermediate doses of 64 g/m3 at 10.0°C and 56 g/m3 at 15.6°C for 24 hours were also 100% successful. Other larvae present in the wood, mainly *Cossus cossus* (Lepidoptera: Cossidae) were also 100% killed. CT products were calculated from the applied doses and were found to be equal to 1000 mg-h/l at 4.4°C, 826 mg-h/l at 10.0°C, 710-786 mg-

h/l at 15.6°C and 619-729 mg-h/l at 21.1°C. At 15.6°C and 21.1°C all pupae were also killed. During 2002, cold-acclimated larvae of ALB were also fumigated at 4.4°C and 10.0°C to determine if they were more resistant to MB. At 80g/m3 doses at 4.4°C, there were several survivors, but at 96 g/m3 at 4.4°C there were no survivors. After CT products were compared, it was evident that there was no increased tolerance to MB at 4.4°C or 10.0°C with winter-harvested wood and cold-acclimated larvae.

The efficacy of cold temperature container fumigations at an 80 g/m3 dosage was tested in Tianjin, PRC during March 2002. Fifty-two containers with durable goods packed wit SWP were monitored. The containers maintained high levels of fumigant over a 24-fumigation, and aerated sufficiently within 24 hours. Ten containers were seeded with a total of 63 naturally infested timbers at 3 locations within the container. The CT product for all containers averaged 1605 g-h/m3, with the lowest value of 1166 g-h/m3. The minimum was similar to the Probit-9 calculated dose (POLO, LeOra software, Berkeley, CA) of 1196 g-h/m3 from 4.4°C chamber tests. There were no survivors among 1109 larvae, whereas 150 of 150 untreated control insects survived.

ALB within timbers were very tolerant of SF at temperatures of 4.4 and 10.0°C. Calculated CT values for Probit-9 mortality with SF at 4.4°C were 2367 g-h/m3 for 24 hours, and 2828 g-h/m3 for 48 hr fumigations. Subsequent confirmatory fumigations at 4.4°C with 136 g/m3 (CT = 1620 g-h/m3) and 160 g/m3 (CT = 2328 g-h/m3) failed to produce 100% mortality. At 10.0°C (4 replicates) a chamber dose of 120 g/m3 produced a CT product of 1293 g-g/m3, with 100% mortality. Probit analysis of data indicated this would produce an estimated 99.9 percent kill. More insects would be needed to affirm this level of control. At 15.6°C a predicted CT of 975 g-h/m3 was estimated for Probit-9 kill. In trials at 15.6°C, a chamber dose of 104 g/m3 produced 100% kill of larvae, pupae and other *Cossus* spp. larvae with a mean CT of 1096 mg-g/m3. At 21.1°C, a Probit-9 CT of 500 g-h/m3 was estimated, but was not tested. A dose of 72 g/m3 may be sufficient at 21.1°C based on data. Additional tests with SF during 2003 at lower doses at 15.6 and 21.1C may produce a practical alternative MB, but not at colder temperatures due to the high doses required. SF fumigations with cold-acclimated larvae resulted in a predicted probit-9 CT of 7004 g-h/m3 at 4.4°C and 3279 g-h/m3 at 10.0C. Such high CTs are impractical to achieve with a 24-hour fumigation, and would be costly.

Preliminary tests with carbonyl sulfide (COS) at up to 80 g/m3 at 4.4°C resulted in less than 5% kill, compared with 100% kill with MB. COS does not appear to be a viable alternative to MB.