REDUCED METHYL BROMIDE, AND SULFURYL FLUORIDE QUARANTINE TREATMENTS FOR BAMBOO POLES.

Alan V. Barak*, USDA APHIS PPQ, CPHST Otis Laboratory, 1398 West Truck Road, Otis ANGB, Buzzards Bay, MA 02542-1329. (AL.BARAK@APHIS.USDA.GOV)

Yang Weidong, Yu Daojian, Jiao Yi, Kang Lin, Chen Zhilin, Kang Lin, Chen Zhinan, Zhang Guiming, Ling Xingyuan. Animal and Plant Inspection and Quarantine Technical Center, Shenzhen Entry-Exit Inspection and Quarantine Bureau of P.R. China. 2049 Heping road, Shenzhen, 518010. P.R. China.

Bamboo is one of the fastest-growing and economically important plants in the world, and it is cultivated widely throughout South China. China annually exports to the U.S. significant quantities of bamboo garden stakes (*Bambusa* spp.). In recent years, Plant Protection and Quarantine Officers (PPQ) of the United States Department of Agriculture, Animal and Plant Health Inspection Service, (USDA-APHIS) have made numerous interceptions of the Cerambycid *Chlorophorus annularis* Fairmaire (Coleoptera: Cerambycidae), the bamboo borer, in bamboo products from China. At least twenty-six different species of insects of quarantine significance were intercepted from 1985-2005 on bamboo garden stakes from China. This species is considered to have high pest risk potential in the trade of bamboo products. Three-fifths of the live insects were cerambycids in nine genera, including *C. annularis.*

For the five years prior to 23 June, 2009, a total of 30,144 bamboo fumigations requiring 35,204 kg of MeBr were conducted in the U.S. (USDA, APHIS 2009). The current APHIS, PPQ treatment is fumigation schedule T404-d, which requires high doses of methyl bromide (MeBr) for 24 hours. No fumigation data exist specific for *C. annularis*. Chinese and American quarantine scientists cooperated in testing to determine if this schedule, or lower doses, would be effective as a quarantine treatment for *C. annularis* infesting dried bamboo poles. A lower dose based on APHIS tests for solid wood packing material (SWPM) failed (3/511 survivors) at 56 g/m^3 for 24 hours at 10.0°C. We therefore tested five progressive doses at five temperatures intermediate between the lower SWPM schedule and the much higher applied doses (for example, 120 g/m^3 for 24 hours at 10.0°C) of schedule T404-d. Fumigations of infested bamboo poles conducted in 403.2-liter chambers with 52 percent vol/vol loading at doses of 48, 64, 80, 96 and 112 g/m3 at 26.7, 21.1, 15.6, 10.0, and 4.4° C, respectively (20 total replicates, with four replicates per dose), had no survivors among 2,847 larvae, 140 pupae and 122 adults. Control replicates (3) had a total of 455 live stages (397 larvae, 31 pupae, and 27 adults).

Tests conducted with a sea/land cargo container loaded to 80 percent capacity with bamboo poles verified the ability of the schedule to maintain effective concentrations over 24 hours in commercial-sized fumigations. We propose a new MeBr bamboo quarantine treatment schedule at reduced rates of applied MeBr (Table 1).

We further investigated the MeBr alternative Sulfuryl fluoride (SF) for *C. annularis* in bamboo. Also discussed here are the results of SF fumigation tests for *C. annularis* in bamboo poles at three doses: 15.6°C at 96g/m^3, 21.1°C at 80g/m^3 and 26.7°C at 64g/m^3, in glass test chambers. Commercial standard fumigations were also conducted in a standard 6.1 meter marine general cargo container loaded to 80% vol/vol with similar bamboo poles, and sufficient levels of SF were obtained during the 24 h fumigations. During the course of the SF tests, a total of 2,424 larvae, 90 pupae, and 23 adults were killed, with no survivors. A treatment schedule using SF is proposed for bamboo as an alternative to MeBr for bamboo poles and stakes at several temperatures tested (Table 2). Both MeBr and SF concentrations were monitored with the Spectros Instruments IR Fumigation monitors, under evaluation for official approval by APHIS, PPQ, Treatment Quality Assurance Unit, Raleigh, NC.

Preliminary tests were done with a new alternative treatment technology employing high vacuum and injection of superheated steam at 75°C. Bamboo poles survived treatment, with no damage, little increase in moisture content, and achieved likely lethal temperatures and commodity cooling in less than one hour.

Table 1. Proposed MeBr Fumigation schedule for *C. annularis* F. in bamboo stakes and poles.

Temperature (C°)	MeBr Applied Dose g/m^3	Minimum Concentrations (g/m^3) at:				CxT
		0.5 hr	2 hr	4 hr	24 hr	g-h/m^3
26.7°C	48	39	29	25	16	537
21.1° C	64	50	36	31	22	690
15.6° C	80	69	47	39	27	870
10.0° C	96	73	54	45	30	985
4.4° C	112	93	67	55	38	1223

Table 2. Proposed sulfuryl fluoride fumigation schedule for of *C. annularis* F. in bamboo stakes and poles.

Temperature (°C)	SF Applied Dose (g/m^3)	Minimum Concentrations at hour (g/m^3)				Min. Target CT (g-h/m^3)
		0.5 h	2 h	4 h	24 h	
15.6 -21.1	96	103	93	87	63	1826
21.1- 26.7	80	85	77	73	53	1536
26.7 or above	64	68	59	53	28	1008