QUARANTINE SECURITY FOR PINK HIBISCUS MEALYBUG WITH METHYL BROMIDE

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Introduction

The pink hibiscus mealybug, *Maconellicoccus hirsutus*, is a serious economic threat to agriculture, forestry, and the nursery industry. It attacks more than 200 plants, trees and shrubs. It was first discovered in the Western Hemisphere in 1983 in Hawaii. Since 1994, it has spread rapidly throughout the southern Caribbean region where it is presently found on at least 22 countries and/or islands and has migrated as far south as the coast of Guyana in South America. Recently, it was discovered in the cities of Calexico and El Centro, Imperial County, California.

In California, the mealybug was found in urban areas and has not yet been found on agricultural crops. In spite of this, quarantine restrictions have already been imposed on some exports from this area. The economic risk from invasion of *M. hirsutus* into U. S. agriculture has been estimated at $750 million per year in the absence of control measures. Because the value of agricultural crops in Imperial County alone is $1 billion, the presence of *M. hirsutus* poses a significant and immediate economic threat to all of California.

To cope with quarantine restrictions, fumigation is the preferred option. The existing USDA-APHIS quarantine treatment schedule for mealybugs is 2-hr fumigation with 48 mg/L of methyl bromide at 21 to 26EC (64 mg/L at 16 to 21EC). However, no information exists on the effectiveness of this generic mealybug treatment against *M. hirsutus*. Thus, our objective was to verify the quarantine security of the USDA-APHIS Treatment Schedule T-104-a-2 against *M. hirsutus*.

Materials and Methods

M. hirsutus was reared at the USDA, ARS, Pacific Basin Agricultural Research Center (PARC), Hilo, HI, where all fumigations were conducted. Five life stages were tested. Fumigation chambers were made from wide mouth Mason® jars (0.95 L) fitted with an injection port consisting of rubber tubing that could be closed by pinch clamp. Fumigant was taken by syringe directly from a commercial compressed gas cylinder and, depending on the intended treatment dose, injected directly into either the fumigation jar or a 3.8 L dose jar, similarly fitted with an injection port, for dilution and subsequent dosing. Methyl bromide concentrations were monitored by gas chromatography.

Life stages of *M. hirsutus* were exposed to a range of concentrations of methyl bromide during 2 hr fumigations at ambient conditions (25EC, 95% RH) to obtain dose response data. In addition, a second series of tests consisted of confirmatory treatments using the APHIS treatment schedule. Following treatment, bioassays were removed from treatment jars and allowed to aerate under hood at least 30 min and then held for mortality counts.

Results

Dose response data for *M. hirsutus* in 2 hr methyl bromide fumigations are shown in Figure 1. The data in each plot fit a sigmoidal logistic function with R^2 = 0.99, 0.97, 0.97, 0.87, and 0.89 for eggs, crawlers, early nymphs, late nymphs and adults, respectively. The egg stage was the most susceptible with an LC_{50} and LC_{99} of 7.10 and 20.18 mg/L, respectively (Table 1). Also, with a slope of 5.12, the egg stage was the most heterogeneous in terms of susceptibility to methyl bromide. The four active life stages were significantly more tolerant than was the egg stage (ca. 3.5-fold and 1.8-fold at the LC_{50} and LC_{95}, respectively). There was no significant difference in susceptibilities among the four active life stages at either the LC_{50} or LC_{99}.

Results of confirmatory tests at the target doses of 48 and 64 mg/L are shown in Table 2. There were no survivors in any treatment. Average doses of 48.8, 46.9, and 46.5 mg/L produced 100% mortality of 10,751 crawlers, 2,732 nymphs, and 1,694 eggs, respectively. Average doses of 58.4, 58.4, and 60.1 mg/L produced 100% mortality of 8,336 crawlers, 2.514 nymphs, and 1,604 eggs, respectively.

Discussion/Conclusions

Methyl bromide was very effective against *M. hirsutus*. Even though the active life stages were considerably more tolerant to the fumigant than was the egg, complete control of all tested life stages was achieved at a dose of 48 mg/L and above (Table 2). A dose of 24 mg/L is the recommended dose for control of this pest in the Caribbean area. The APHIS treatment schedule for mealybugs recommends a dose of 48 mg/L at temperatures between 21 and 26EC. Thus, based on our toxicity data, the treatment schedule should provide quarantine security against *M. hirsutus*.

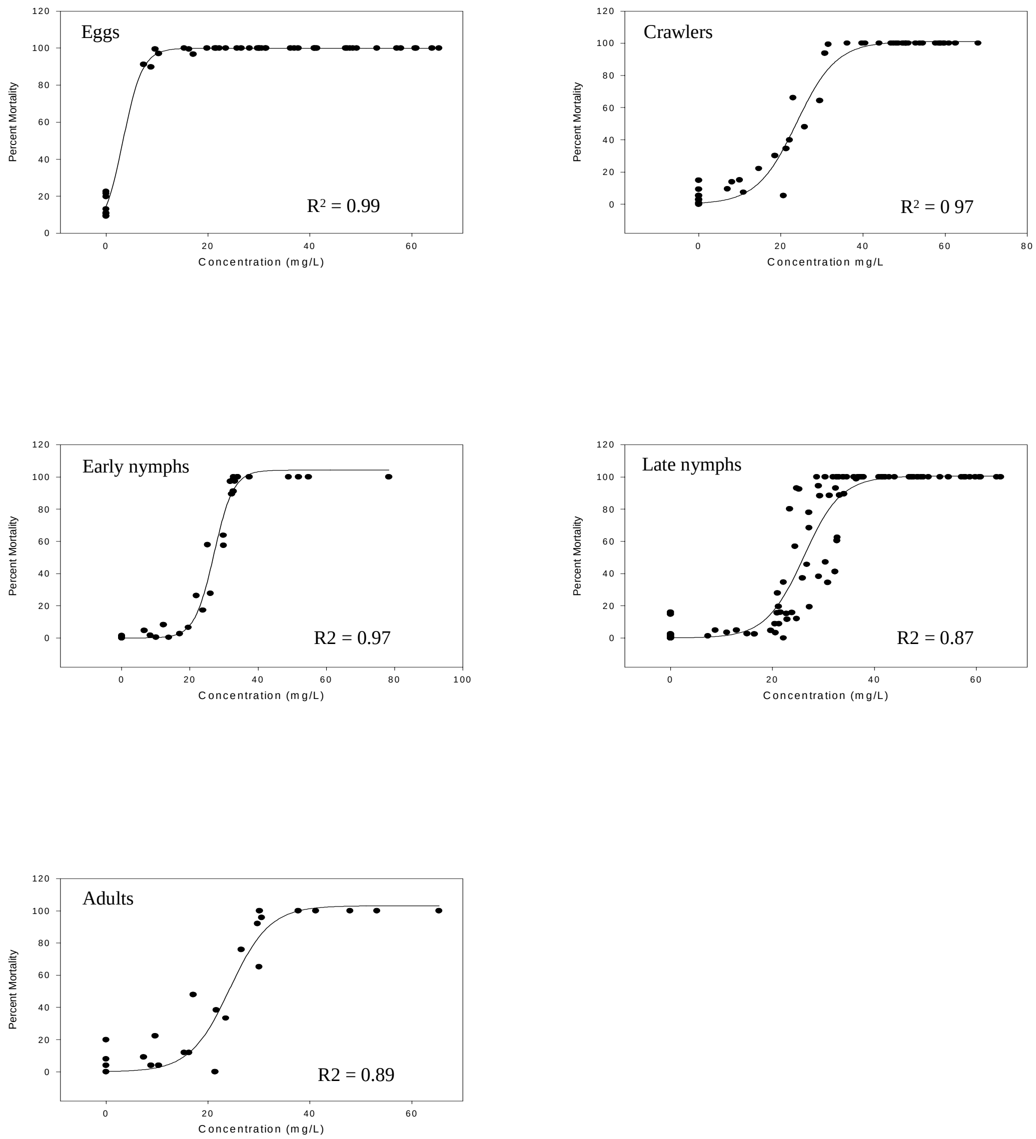

Figure 1. Non-transformed dose-response data for five life stages of the pink hibiscus mealybug, *Maconellicoccus hirsutus*, in two-hour fumigations with methyl bromide at ambient conditions (25EC and 95% RH).

Table 1. Probit transformed responses from regression analyses of five life stages of the pink hibiscus mnealybug, *Maconellicoccus hirsutus*, resulting from two-hour laboratory fumigations with methyl bromide at ambient conditions (25°C and 95% RH).

Life stage	n	Slope	LC_{50} (mg/L)	LC_{99} (mg/L)
Egg	3,091	5.12 ± 1.32	7.10	20.18
Crawler	4,713	12.9 ± 0.45	25.10	38.02
Early nymph	835	16.2 ± 0.67	26.50	36.86
Late nymph	2,591	13.2 ± 0.28	25.02	37.57
Adult	99	17.1 ± 2.78	25.68	35.09

Table 2. Mortality data from confirmatory tests of two hour fumigations with methyl bromide against eggs, late nymphs and crawlers of pink hibiscus mealybug, *Maconellicoccus hirsutus*, using the USDA-APHIS treatment schedule for mealybugs at ambient conditions (25°C, 95% RH).

	Target dose (48 mg/L)			Target dose (64 mg/L)		
Life stage	Ave dose (mg/L)	No. treated	% mortality	Ave dose (mg/L)	No. treated	% mortality
Crawler	48.8	10,751	100	58.4	8,336	100
Late nymph	46.9	2,732	100	58.4	2,514	100
Egg	46.5	1,694	100	60.1	1,604	100