

Rapid Response Efforts to Prevent the Establishment of the Asian Tiger Mosquito, *Aedes albopictus* (Skuse), in California

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Summary

Originally from southeast Asia, the day-time biting mosquito *Aedes albopictus*, has become established throughout the eastern and southern U.S. and Hawaii. This mosquito is an important vector of several diseases, including dengue virus.

New shipments of this mosquito were discovered in California in 2001 in packages of “lucky bamboo” plants (*Dracaena sanderiana*). Thirty importers of “lucky bamboo” plants were inspected and 40% were found to be infested. Nursery employees and nearby residents in several counties were being bitten.

Immediately a control protocol including insecticide applications, monitoring, and import restrictions was employed. Follow-up monitoring during the summer of 2004 found more *Ae. albopictus* populations and immediate action was taken to eradicate these populations. Continued monitoring and if necessary rapid control action will continue to prevent the establishment of *Ae. albopictus* in CA.

Although the Asian tiger mosquito may not have been eradicated, there are many elements to this story which merit being called a success, namely:

- Monitoring activity at nurseries and surrounding areas
- Control programs were implemented quickly
- The importation embargo
- The rapid response and cooperation between many participating agencies (*Dracaena* importers and exporters, vector control districts, California Department of Health Services, Center for Disease Control/Division of Global Migration and Quarantine, US Department of Agriculture/Plant Protection and Quarantine)

The Invader

Where is it?

Aedes albopictus (Skuse), commonly called the Asian tiger mosquito, originated from southeast Asia (Madon *et al.*, 2002) where it is widely distributed (Madon *et al.*, 2003). Its typical importation route into the U.S. was within shipments of used tires. Because of these shipments, *Ae. albopictus* can now be found throughout the eastern and southern U.S. The first established population was detected in Houston, Texas in 1985. It can now be found in 26 states east of the Mississippi (Madon *et al.*, 2003) and in Hawaii (Anonymous, 2001). A few immature *Ae. albopictus* mosquitoes were found in California during 1971 and 1987 and each time the populations were eradicated (Linthicum *et al.*, 2003).

Aedes albopictus is a successful container breeder (immature mosquitoes develop in any container that holds water, for example, in tire piles, vases at cemeteries, saucers under pots, catch basins, and underground storm drains). This mosquito easily establishes in new areas and because they can breed in a number of different microhabitats, eradication efforts elsewhere in the U.S. have mostly failed (Madon *et al.*, 2002; 2003).

Why don't we want it?

In the U.S., *Aedes albopictus* is regarded as the most significant nuisance mosquito and disease vector (Madon *et al.*, 2003). It has earned the title of most important nuisance mosquito because it is an aggressive biter and, in contrast to most mosquitoes that feed during dawn and dusk, *Ae. albopictus* bites during the day (Madon *et al.*, 2003). It is listed in “100 of the World’s Worst Invasive Alien Species” compiled by the Invasive Species Specialist Group (ISSG), part of the World Conservation Union (IUCN) (<http://www.issg.org/booklet.pdf>).

Although it is not known to have transmitted disease in the U.S. (Madon *et al.*, 2003), it is a serious vector of disease in other parts of the world. In Asia (e.g. Japan and southern China) it is the second most important vector of dengue virus, which causes a disease called dengue fever. It has experimentally been found to transmit several viruses already found in the U.S. such as eastern equine encephalitis, western equine encephalomyelitis and West Nile virus. During 2001 in Pennsylvania and five other states, *Ae. albopictus* mosquitoes were found carrying West Nile virus. Because this disease has been isolated from mosquitoes in the U.S. and because *Ae. albopictus* has been demonstrated to vector the disease, *Ae. albopictus* could be important in the ecology of West Nile virus (Linthicum *et al.*, 2003). *Aedes albopictus* was also suggested to be the vector of 95 dengue cases reported by the Department of Health in Hawaii (Madon *et al.*, 2002).

In southeast Asia, dengue fever had reached epidemic proportions in 2001 and 2002. *Aedes albopictus* brought over on “lucky bamboo” (*Dracaena sanderiana*) shipments could have potentially vectored the dengue virus to California. Since all four serotypes of the virus are endemic to southeast Asia, the U.S. introduction of dengue hemorrhagic fever—the most serious form of the disease—could have been possible. Dengue hemorrhagic fever can occur when a person is infected with one serotype and then at a later time is infected a second time by a different serotype. The dengue virus can also infect the reproductive organs of females causing some eggs to be infected with the virus, and thus passing the virus on to the next generation, but this is rare (Linthicum *et al.*, 2003).

The Success Story

Infestation

In June, 2001 shipments of “lucky bamboo” (*Dracaena sanderiana*) at the port in Los Angeles, CA were found to contain *Ae. albopictus*. *Dracaena* plants typically were shipped dry using airfreight. However, transport using cargo ships began in January 2000 due to increased demand (Linthicum *et al.*, 2003). Transoceanic freight shipments take 12-15 days (Madon *et al.*, 2002). To keep them green, the plants were shipped in crates containing 5-10 cm of water (Linthicum *et al.*, 2003). Adult *Ae. albopictus* were observed to fly from opened containers by USDA Plant Protection Quarantine (PPQ) inspectors, and immature stages were found in the water the plants

were shipped in (Madon *et al.*, 2003). Eggs attached to the stems of the plants were also considered as a possible form of importation (Madon *et al.*, 2003).

After *Ae. albopictus* was observed, 30 importers of *Dracaena* plants were inspected and 40% (12 out of 30) of their stock was found to be infested. In six CA counties, 15 populations near the importers' operations were discovered (Linthicum *et al.*, 2003). Employees at nurseries receiving shipments of *Dracaena* complained of day-time biting mosquitoes. Residents near the nurseries were also being bitten.

Steps taken to prevent establishment

Once the infestations were detected, a control protocol was rapidly employed. Containers arriving at California ports were treated with an insecticide designed to kill the adults (an adulticide). During the insecticide application, the containers remained sealed to prevent adult mosquitoes from escaping. Nurseries that received *Dracaena* shipments were also treated with adulticides and the containers used for the plants were treated with larvicide. The Center for Disease Control (CDC) used CO₂-baited traps for adult mosquitoes, ovitraps (traps that monitor egg laying), and landing-biting observations (using people as "bait") to monitor for *Ae. albopictus* populations to determine if control efforts were successful. Nurseries were treated until no adults were monitored. Even though shipments of *Dracaena* were treated at the port, containers at the nursery were treated with larvicides in case immatures or eggs attached to plant stems hatched later (Madon *et al.*, 2003).

Additionally, on July 2, 2001 an embargo was enacted by the CDC/Division of Global Migration and Quarantine (DGMQ) with the United States Department of Agriculture (USDA) within 20 days of the first observation of *Ae. albopictus* on "lucky bamboo". The embargo prohibited shipment of *Dracaena* in standing water (Madon *et al.*, 2003). Current shipments of "lucky bamboo" are bundled, 10-20 plants together, and kept green by placing the stems in water-absorbent material (e.g. hydrogel) in plastic bags, with no free-standing water (Linthicum *et al.*, 2003; Madon *et al.*, 2003).

Monitoring the following year (2002) determined that two populations successfully overwintered. One population was found in a San Bernardino county nursery and another close to a nursery in Los Angeles county. Containers with immatures were drained and the nursery was treated with adulticides (Linthicum *et al.*, 2003).

Recommendations for packing *Dracaena* were developed by the California Department of Health Service (CDHS) and the CDC in response to a population believed to be a new introduction after the dry shipments were implemented. It is possible that oviposition could occur on the plants while they are processed for shipping. These eggs can remain viable during shipment and hatch once the plants are placed in water upon arrival. The main goal of the recommendations was to pack plants in a mosquito-free facility. Packing facilities were encouraged to have automatic closing screens and doors. Pesticides could be used in the facility and within the boxes holding the *Dracaena* plants before placing them within the sealed cargo container (Linthicum *et al.*, 2003).

Follow-up monitoring during the summer of 2004 found more *Ae. albopictus* in one Los Angeles nursery and in the City of Orange. Immediate action has been taken to eradicate these populations. Continued monitoring and if necessary rapid control action will continue to prevent the establishment of *Ae. albopictus* in CA (Madon, 2004; Meyer, 2004, personal communications).

More Information

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