

REDUCED MOSQUITO PRODUCTION IN CEMETERY VASES WITH COPPER LINERS

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ABSTRACT. Water-holding stone vases were sampled in 4 central Florida cemeteries to compare the prevalence of mosquitoes in containers with and without metallic liners. Overall, immature mosquitoes were found in more than 60% of the vases lacking liners and in more than 50% of the vases with aluminum liners. Significantly fewer vases with copper liners were positive for mosquitoes. High mortality and a lack of development were observed in a field test involving the introduction of *Aedes aegypti* larvae into stone vases with copper liners.

In many Florida cemeteries, stone vases provide suitable habitats for immature *Aedes albopictus* (Skuse) and *Ae. aegypti* (Linn.). Rainfall accumulates in these containers due to: 1) a lack of a drain hole, 2) a plugged drain hole, or 3) the presence of a liner inserted into the vase. Metallic liners made of aluminum or copper are much more common than plastic liners in many central Florida cemeteries. Previous studies have shown that mosquitoes frequently occur in many different types of flower-holding containers in cemeteries, except bronze vases (O'Meara et al. 1992, Schultz 1989, Barrera-Rodriguez et al. 1982). Since copper is a major component of bronze vases, this study was conducted to determine if mosquito production was also inhibited in stone vases with copper liners.

During early summer in 1991, water-holding stone vases in 4 central Florida cemeteries were sampled for immature *Aedes*. Water was sucked out of stone vases with a meat baster or poured from liners into collection bottles. All field collections were returned to the laboratory for sorting and species identification. At each cemetery, 3 types of stone vases (i.e., those without liners, those with copper liners and those with aluminum liners) were sampled on the same date. In

3 of the cemeteries all 3 types of containers were common, but in one (Oak Hill Cemetery, Polk County) containers with aluminum liners were much less common than the 2 other types. Efforts were made to sample the 3 container types in comparable habitats.

In another experiment, we added 25 first instar *Ae. aegypti* larvae, 250 ml of water and approximately 200 mg of liver powder to each of 20 vases with aluminum liners and 20 vases with copper liners and then checked these containers 3-4 days later to evaluate survival and development of the mosquito larvae. Prior to the addition of the larvae, the liners were emptied of water and the debris removed.

At each of the 4 cemeteries surveyed, immature mosquitoes were generally less prevalent in the stone vases with copper liners than in vases without liners or with aluminum liners. Only 11.7% of the containers with copper liners were positive for mosquitoes. By contrast, mosquitoes were found in more than 60% of vases lacking liners and in more than 50% of the vases with aluminum liners (Table 1). Based on G tests (Sokal and Rohlf 1981), the percentages from containers with copper liners were significantly

Table 1. Influence of metallic liners on the occurrence of immature *Aedes* in stone vases in cemeteries.

Cemetery ²	Stone vases ¹						
	Total no. sampled	Without liners		With aluminum liners		With copper liners	
		No. sampled	Percent positive ³	No. sampled	Percent positive ³	No. sampled	Percent positive ³
A	97	42	59.5	17	47.1	38	18.4
B	38	11	81.8	14	71.4	13	7.7
C	35	12	75.0	10	50.0	13	7.7
D	41	14	42.8	14	50.0	13	0.0
Totals	211	79	62.0 ^a	55	54.5 ^a	77	11.7 ^b

¹ Only vases with >25 ml of water were sampled.

² A = Oak Hill Cemetery, Polk County; B = Rose Hill Cemetery, Hillsborough County; C = Orange Hill Cemetery, Hillsborough County; D = Centro Asturiano Memorial Park, Hillsborough County.

³ Treatments with the same letter do not differ significantly ($P > 0.05$) as determined by G tests.

smaller ($P < 0.01$) than those from unlined containers, or from those with aluminum liners.

Most of the immature mosquitoes collected were either *Ae. aegypti* or *Ae. albopictus*. Both species were common in collections from the 3 cemeteries located in and near Tampa (Hillsborough County). In the Oak Hill Cemetery (Polk County), the dominant mosquito was *Ae. aegypti* followed by *Aedes triseriatus* (Say). *Aedes albopictus* was not detected in this cemetery until later in the year. Because they were rarely encountered, vases with fresh-cut flowers were not included in our survey. Hence, immature *Culex* were seldom collected.

In our field test, which compared the survival and development of *Ae. aegypti* in stone vases with copper or aluminum liners, only 2 of 20 containers with copper liners had live larvae at the end of the test period, and none of these larvae had developed to the 4th instar. On the other hand, 16 of 20 containers with aluminum liners had some larvae that survived the test period and development to the 4th instar was noted in 14 containers. The effects of copper liners on mosquito survival and development were similar to those observed in studies using bronze vases (O'Meara et al. 1992). Various copper compounds are used as fungicides and bactericides. Thus, it is possible that the reduced mosquito production in bronze vases and stone vases with copper liners is due, in part, to the adverse effects of Cu^{++} on the mosquito's food supply. However, additional studies are needed to evaluate this hypothesis.

When fresh-cut flower arrangements are regularly placed in a graveside stone vase with a functioning drain hole, a liner is needed to retain water so that the flowers will not wilt prematurely. Most stone vases are either an integral part of the gravestone or permanently attached to this structure (Fig. 1). Thus, the removal of plant debris and stagnant water from stone vases can be greatly facilitated by the presence of a liner. However, in the 4 cemeteries where field studies were conducted, fresh-cut flowers were rarely found in permanent stone vases. Although many of the stone vases had metallic liners, they usually either lacked fresh-cut flowers or contained artificial ones. Under these conditions, water accumulates needlessly in many stone vases and, in cases involving aluminum liners, enhances the likelihood of mosquito production. Currently, most of the new metallic liners being placed in central Florida cemeteries are the aluminum type. More en-



Fig. 1. A metallic liner removed from a free standing stone vase.

couraging from the standpoint of mosquito abatement is the general shift away from stone containers toward the use of bronze vases.

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