

Genetic evidence for insecticide resistance in sibling species of the mosquito *Anopheles quadrimaculatus*

Four sibling species of *Anopheles quadrimaculatus* have recently been detected. These species (provisionally named A, B, C, D) can be identified using a small number of allozyme loci (Narang *et al.* 1989a, b; Lanzaro *et al.* 1990); they do not interbreed in the wild. We find that species A is widespread and common throughout Mississippi, and that it is the main mosquito pest in the Mississippi Delta. Species B and D are restricted to relatively undisturbed forest habitats near major rivers to the East and South of the Delta, and we have not found species C in Mississippi to date. Where species occur together, as in the Noxubee National Wildlife Refuge, near Starkville, MS, there are some differences in the frequencies of the species between different sites. However, the three species A, B, and D can usually be found together in the same adult resting sites, and as larvae, in the same ponds, ditches, and lakes within the Refuge.

A major difference between the species is in insecticide resistance. We collected live females from resting sites, and allowed them to lay eggs individually. We then reared the progeny of these females separately in the laboratory at Mississippi State, and tested them against two classes of adulticide. Tests were done using a modification, for mosquitoes, of F.W. Plapp's vial test for use with *Heliothis*. In addition a small number of mosquitoes from each brood were electrophoresed to determine to which sibling species the brood belonged. Fig. 1 shows a plot of LD₅₀s for two insecticides estimated on each set of progeny from individual females collected in 1991.

Various conclusions can be drawn: (1) Species B and D from Noxubee are as susceptible to malathion and permethrin as a laboratory strain of species A that was domesticated in Florida in the 1940s. (2) Species A, whether from the Delta or from Noxubee, is highly resistant to malathion (about 10x-1000x); in fact it was hard to estimate LD₅₀s to malathion in this species since some individuals almost always survived our highest doses. (3) Delta populations of species A are about 10x more tolerant of permethrin than Noxubee populations of species A.

This evidence, together with corroborative data from other years and other laboratories, suggests that malathion might be a poor choice of insecticide to control *Anopheles quadrimaculatus* species A in Mississippi. However, malathion might still be useful in areas where species B or D are major pests; unfortunately such areas are rare in Mississippi. Resistance in species A to malathion should be checked under more realistic field conditions since it is possible that our vial tests are unreliable indicators of problems in the field. The data also suggests that the Delta populations of species A are evolving resistance to pyrethroids, which might soon affect control in the area. For the moment, however, operators appear to be having no difficulty controlling populations of *Anopheles quadrimaculatus* species A using formulations of resmethrin near Cleveland, in the Mississippi Delta, from where most of our Delta samples were taken.

LD₅₀s for single female broods

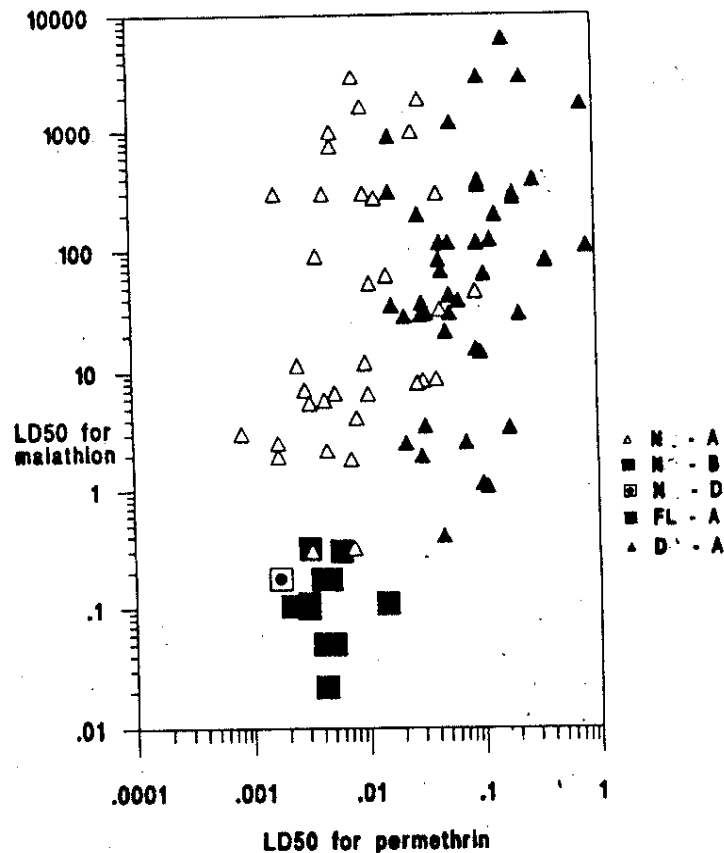


Figure 1. Insecticide dosage-mortality tests on the progeny of individual female *Anopheles quadrimaculatus* (sensu lato). Key: N - A = Species A collected in Noxubee National Wildlife Refuge, MS; N - B = Noxubee species B; N - D = Noxubee species D; FL - A = Laboratory strain of species A, first collected in the 1940s in Florida; D - A = Delta samples of species A, collected from near Cleveland, MS. Each point represents LD₅₀ estimates (g per vial) from a single female's progeny, except for the FL - A points, which represent samples from a laboratory population.

References

- Narang, S.K., Kaiser, P.E. & Seawright, J.A. 1989. *J. Am. Mosq. Control Assoc.* 5: 317324.
- Narang, S.K., Toniolo, S.R., Seawright, J.A., Kaiser, P.E. 1989. *Ann. Entomol. Soc. Amer.* 82: 508515.
- Lanzaro, G.C., Narang, S.K., Seawright, J.A. 1990. *Ann. Ent. Soc. Am.* 83: 578585.

James Mallet
Galton Laboratory, Department of Genetics and Biometry
University College London
4 Stephenson Way
LONDON NW1 2HE, UK

and
Robert S. Fritzius
Department of Entomology
Drawer EM
Mississippi State University
Mississippi State, MS 39762

