Program Review:

Research seeks new ways to combat mosquitoes

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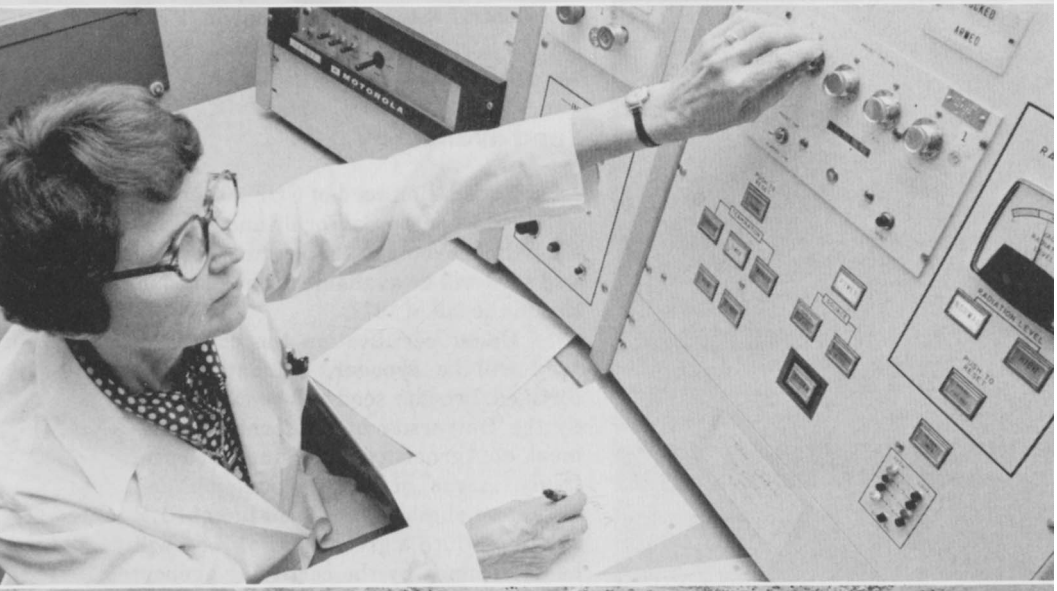

Working with 63 mosquito control agencies throughout the state, University of California researchers have completed three major mosquito control projects:

- Economists analyzed mosquito control methods from 1955 to 1974. They found that chemical and nonchemical controls had effectively reduced mosquito populations. Getting rid of the water in which mosquitoes breed was 4½ times more effective and 18 times cheaper than chemical sprays in reducing floodwater mosquitoes.
- Scientists developed ways of colonizing and multiplying the mosquitofish, *Gambusia*, at a cost of $2.62 per pound (about 700 fish).
- Researchers learned to make synthetic diets needed to rear mosquitoes used in testing biological and chemical controls.

Current UC studies include: new biological insecticides that thwart the mosquito's development to adulthood; ways of circumventing mosquito resistance to compounds; more effective ground spray rigs; use of fungi, parasitic worms, and diseases to destroy mosquitoes; and flight range habits of the pest.

Irradiation studies

UC scientists maintained 31 mosquito colonies at Berkeley and Bakersfield to study disease transmission by *Culex tarsalis*, which carries Western equine encephalitis (WEE) and St. Louis encephalitis (SLE). Encephalitis is an inflammation of the brain: WEE affects man and horses, SLE affects only man.

It was found that *Culex* species such as the house mosquito, *C. pipiens*, may transmit St. Louis encephalitis if it is introduced from Mexico into certain southern California areas.

Large numbers of male *C. tarsalis* were irradiated to produce defective chromosomes. The radiation-altered males will be released to mate with "wild" females at an isolated site east of Bakersfield.

Genetic alteration by radiation to suppress disease-carrying mosquito populations. *Top*, the mosquito *Culex tarsalis*; *center*, Dr. Monica Asman at the control panel of the cobalt-60 irradiator; *bottom*, sites east of Bakersfield, where genetically altered males will be released.

Radiation induces breaks in the chromosomes—the units that carry heritable factors—causing a change in the position of the inherited factors. This disturbs the sequential order of chromosome-forming events, and about 75 percent of the formed sperm cells cannot father offspring; thus field populations could be drastically reduced. The 25 percent that are able to father offspring pass on the abnormality. Subsequent generations continue to carry the genetic flaws and therefore, it is hoped, will continue to be hampered in reproduction.

This will be the first attempt in the United States to use genetically altered mosquitoes as a means of suppressing large numbers of a disease-carrying type of mosquito.

The possibility of changing mosquitoes to make them inefficient carriers of the WEE and SLE viruses will be investigated. Genetically altered males mating with wild mosquitoes could father a whole new race that can't carry disease.

Can resistance be overcome?

Chemicals are still the principal defense against mosquitoes. Since several mosquito species (including disease carriers) are able to resist most of the older chemicals, University scientists continually assist in developing new compounds.

The insecticide Abate, when used with a synergist called DEF, suppressed the resistance of the southern house mosquito, *Culex quinquefasciatus.*

Mosquitoes had developed a 200-fold resistance to one insect growth regulator (IGR), while there was no resistance to another IGR, Dimilin. Similar IGRs have been effective against mosquitoes at very low dosages, represent little danger to mammals, and have no harmful effect on non-target organisms (fish, for example). Registration of these compounds is underway.

Synthetic pyrethroids and aliphatic amines showed up well in University tests. The latter compound costs 20 to 50 percent less than currently available materials.

UC engineers have redesigned ground rigs used to apply mosquitocides as aerosols. Nozzles were developed to boost output and obtain better mosquito kill. The engineers collected data on human safety in operating these machines. They worked with weather bureau stations in studies of atmospheric turbulence, seeking aerosol dispersal data useful to Mosquito Abatement District managers.

Because pesticides can harm fish and other natural enemies of mosquitoes, researchers tried ways of removing stagnant water in which mosquitoes breed from 150 miles of weed-covered irrigation drains in a southern California irrigation district. By mechanically clearing only one side of the ditches, they obtained good water flow, got rid of stagnant water, and effectively reduced mosquito breeding.

Mosquito research expenditures by the University of California approximate 10 percent of the roughly $15 million spent for local mosquito control in California. In recent years the state's mosquito control program has steadily expanded.

No serious outbreaks of malaria occurred in California in 1975, and a two-year record was set when no cases of mosquito-borne encephalitis in humans were reported. UC investigators working with the Statewide Surveillance Program on encephalitis believe that considerable credit must be given to California's mosquito control agencies for the efficacy of their mosquito suppression measures.

However, in 1975 and 1976 there were SLE epidemics in the Midwest, the South, and the East, and a Venezuelan equine encephalomyelitis epidemic occurred in Texas in 1971. UC scientists continue to develop alternative, environmentally safe methods for mosquito control as more and more mosquito populations become resistant to commonly used insecticides.

The work of the following researchers was cited: **UC Berkeley:** Asman, Sr., M., and P. McDonald; Dadd, R.H.; Garcia, R.S.; Johnson, C.R.; Schaefer, C.H., and T.M. Miura. **UC Davis:** Akesson, N.B.; McClelland, G.A.H., and S.L. Bennett; Moore, C.V.; Washino, R.K. **UC Riverside:** Federici, B.A.; Georghiou, G.P.; Legner, E.F.; Mulla, M.S., and Y.S. Hwang; Platzer, E.K. **Schools of Public Health:** (UC Berkeley) Reeves, W.C., J.L. Hardy, and Sr. M. Asman; (UCLA) Work, T.H.

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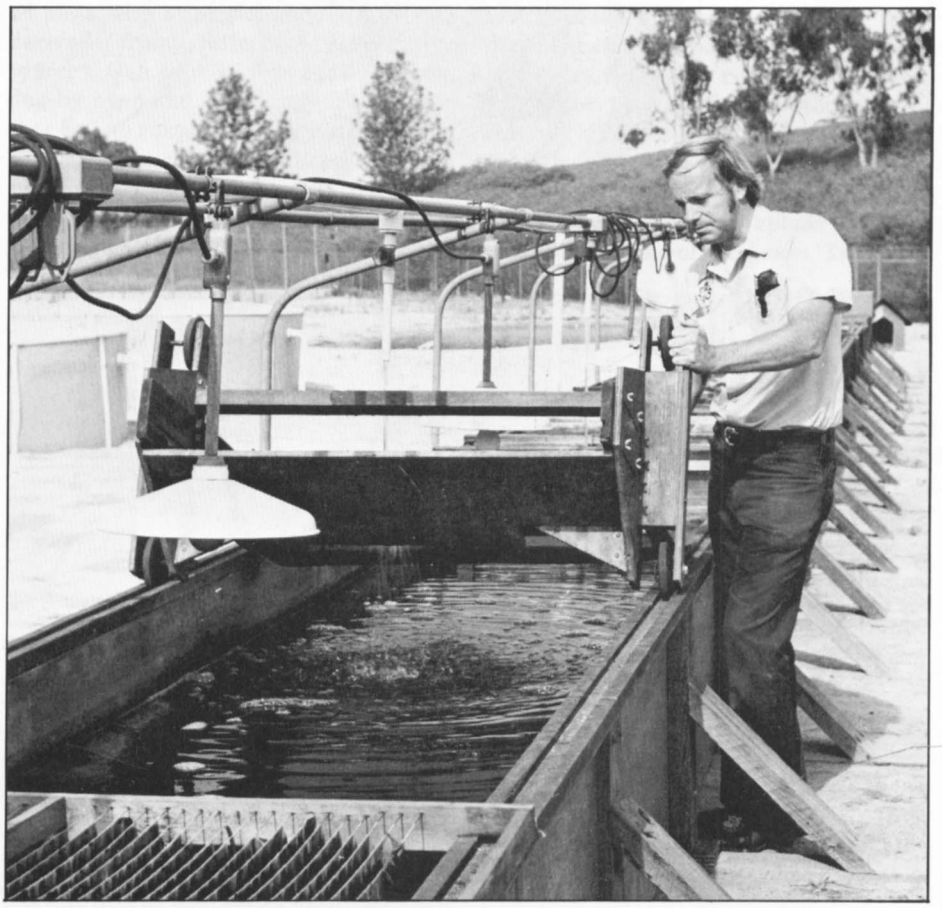

Gary Reynolds, Fisheries Biologist of the Orange County Vector Control District, at the mosquitofish rearing facility.