Mosquito and fly problems in dairy waste-water systems

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Properly constructed, well-managed dairy waste holding ponds minimize mosquito problems.

Polluted water from dairy milk barns directed into holding ponds may provide a rich environment for the production of mosquitoes and filth flies. Drylot dairies use an average of 80 gallons of water to wash cows before milking and to clean the barn interior. The waste water includes cow manure, spilled feed, milk strippings and solids, and cleaning agents.

Off-ranch drainage of this water is prohibited by law, and more dairies are now directing these wastes into ponds, the design and operation of which are left solely to each dairyman. Cow manure mixed with earth and bedding material from loafing corrals also may be discharged into these ponds. This latter practice causes an overload of solids in the liquid system originally designed to receive waste water from the milk barn.

The most common mosquito found in polluted water is the southern house mosquito, *Culex pipiens quinquefasciatus*, a carrier of encephalitis. The presence of solids in waste-water ponds also may give rise to houseflies (*Musca domestica*) and stable flies (*Stomoxys calcitrans*).

Because numerous mosquito abatement districts (MADs) reported continuous mosquito control problems on dairies, and because of the potential increase of dairy operations in the San Joaquin Valley, representative dairies in Fresno County were surveyed to evaluate mosquito and fly production sources in waste-water ponds.

Eighteen of 128 grade A dairies operating within the boundaries of the Consolidated and Fresno MADs were included in the study; 13 had ponds, and 5 had pipeline systems. Inspections were conducted biweekly during the summer by University of California staff and monthly during the rest of the year by MAD personnel. Standard sampling methods were used to detect the presence of mosquito larvae and fly maggots within the pond habitat.

The survey included dairy herd size, physical components of waste-water systems, number and type of acres for irrigation, mosquito production ratings, and control costs of the dairies. Twelve of the 13 dairies with ponds had from 8 to 115 days' water storage capacity, all less than the 4 to 5 months recommended by the University; 1 dairy had over a 2-year storage capacity, and the single large pond was difficult to manage. Recommended pond depth is 14 feet, but only 5 dairies conformed to this specification, and 3 dairies had pond depths of only 3 to 5 feet. Such shortcomings in pond construction necessitated frequent discharge to crops or fallow soil to accommodate the large daily pond inflow from the milk barn.

All but 4 dairies had moderate to severe weed growth along their pond edges. Floating solids (roughages not eaten or not digested by cows) were present at 6 of the 11 one- and two-pond dairy systems. Solids completely covered the pond surface at 2 dairies, and odors were extremely strong because of anaerobic conditions.

In general, pipeline systems were better managed than the pond operations. One dairy had dense weed growth and moderate amounts of surface solids along the ditches in which piped barn effluent was used for crop irrigation.

Mosquito production in some waste-water ponds and in ditches that received pipeline polluted water began in May and reached high density from August through October. Larval densities of *Cx. p. quinquefasciatus* ranged from 5 per dip in May to 20 in July, and from 90 to more than 100 during September and October, respectively. *Culex tarsalis*, the primary vector of encephalitis, and usually found in fresh water, occurred in light density (5 per dip) in July on one dairy and in moderate density (25 per dip) from July through October at another.

Ponds and ditches with dense vegetation were responsible for the greatest production of mosquitoes. In general, mosquito densities were relatively light to moderate in water found between cracks in the solids covering some pond surfaces. The organic content of these ponds may have increased anaerobic levels too high for optimum mosquito development.

Pipeline systems that mixed effluent with well water and then used it immediately for crop irrigation caused no mosquito problems. The one pipeline dairy that extensively delivered its waste water by ditch for cropland irrigation produced *Cx. p. quinquefasciatus* and *Cx. tarsalis* in the weed-covered ditches from July through September. More extensive production of these species occurred in polluted water that was allowed to overflow from ponds or to escape from cracks or holes in banks, and that which was directed from the deliberate bypass of ponds onto adjacent pastures, roadside ditches, or fallow land.

Costs for mosquito control (materials

and labor) were obtained from both MADs' operational records at the close of the study. As expected, larger expenditures on those dairies found to have severe or moderate mosquito production problems associated with poor waste-water or pond management had the highest control costs (totals of $74 to $260 in 1976). Dairies with minor mosquito production and few if any weed or sludge problems had lower control costs ($12 to $35).

The total cost of $1,487 for mosquito control in 1976 on 14 dairies (13 with ponds, 1 with pipeline) was only 0.2 percent of the combined operational budgets ($980,100) of the two MADs. Although this amount may be small, mosquito production originating from problem dairy waste-water systems has an impact on residents of nearby towns and rural-urban developments. Likewise, mosquito control on cropland repeatedly flooded by mismanaged, polluted dairy waste water often can be costly. For example, a $1,400 extra expenditure was necessary at 1 dairy for this purpose.

Waste-water pond and pipeline systems caused only minor fly problems. Sources for house and biting stable flies were associated with "islands" of solids floating on pond surfaces or in ditches that received a large amount of solids in the barn runoff water. Still, the greatest density of fly breeding occurred in sources found in loafing corrals, barns, and calf pens. Poor manure management associated with improper drainage and poor sanitation of calf pen facilities were responsible on nearly every dairy.

Mosquito and fly production from dairy waste-water ponds and ditches could be minimized and in some cases eliminated by: (1) use of soil sterilants and herbicides to control emergent vegetation on bank margins of ponds and ditches; (2) better management of the water-solids ratio to avoid high organic pollution levels; (3) proper pond construction to increase storage capacity (including adjustment for winter rain runoff); (4) maintenance of pond embankments to avoid leakage to adjacent cropland; (5) construction of pond borders to facilitate inspection and vehicle service.

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Summertime aerial view of Petaluma salt marsh study site, a habitat dominated by a single plant species — pickleweed.

Recirculation ditches have long been used in San Francisco Bay Area marshlands to reduce mosquito breeding habitats and improve access to these areas by predatory fish.