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The mounting Culex p. quinquefasciatus problem in urban East Africa

INTRODUCTION

The rapid urbanization in Eastern Africa has ushered in unprecidented increases in populations of Culex quinquefasciatus mosquitoes which flourish mostly in such on-site sanitation systems as pit latrines, soakage pits, septic tanks and such other habitats as ditches and drains whose water is highly polluted with organic matter. Other favoured, but less abundant sites include unkept waste stabilization ponds and waste-discharge ditches from agroindustries, at sisal and sugar processing plants. These mosquitoes may also breed in clean water as that in wells, tanks, cisterns, domestic earthenware, peridomestic discarded containers, old tyres and coconut shells. These breeding sites have become more readily available with urbanization with the consequence that Cx. quinquesfasciatus is the most prevalent mosquito in urban East Africa today.

PUBLIC HEALTH IMPORTANCE

Besides constituting the most prominent biting nuisance, Cx. quinquefasciatus is the major vector of urban Bancroftian filariasis, an often disfiguring disease, which is highly endemic in coastal East Africa (1,2,3,4). Infection rates range between 6% and 53% and may average between 20% and 25%. The infection rate in Dar es Salaam is currently about 15%. The commonest clinical manifestation is the hydrocoele and hydrocoele rates in males over 25 years may be over 60% in some localities. Large hydrocoeles result in dragging and tiredness which must inevitably lead to decreased ability to engage effectively in manual work. Surgical and treatment costs may be substantial in endemic areas and hydrocoeles are a stigma and socially unacceptable (5). In East Africa, elephantiasis is relatively rare, but lymph gland enlargement, filarial fever and funiculitis are extremely common. Bancroftian filariasis is therefore a significant public health problem in East Africa.

CONTROL METHODS

Cx. quinquefasciatus has proved difficult to control in many areas. Attempts at the control of these mosquitoes in Tanzania date back to the 1950s. However, despite heavy investments in control, mosquito populations in both the treated and untreated areas have been rising over the years (6). When the species became resistant to the organochloride compounds (7) there was a switch to the use of organophosphates such as diazinon, malathion and chlorfenviphos. However, it is with chlorpyrifos (Dursban) that good results have been recorded (8,9). Recent studies have however shown very high levels of resistance to this insecticide in Tanzania (10). This has necessitated an increase in spraying frequency from once in every 9 weeks in the early 1970s to once every two weeks now, with consequent strains on finances and logistics. The current paucity of foreign exchange has often meant that control activities have not been regular and therefore ineffective. The use of domestic detergents may also have worsened the situation (11). Furthermore, the mushrooming of semi-urban areas, the increase in waste water, the installation of certain types of sanitary facilities are all rapidly increasing the number of potential breeding sites. It has however been suggested that selective larviciding when the insecticides are available may reduce costs (12).

Availability of appropriate materials and costs as well as some elements of human behaviour have precluded effective use of personal protective measures in Tanzania. There is no suitable method of attacking the adult mosquitoes nor is there a suitable biological control agent. The immediate consequences have been significant increases in biting densities in urban and suburban areas (13). Given the relatively good vectorial competence of this mosquito species and the fact that breeding occurs all year round due to the nature of the breeding sites, the resultant implications on disease transmission cannot be underestimated.

ALTERNATIVE CONTROL METHODS

Use of bacteria:

Bacillus thuringiensis (H-14) has potential for mosquito control and is relatively safe for operational use (14). In a small scale field trial, B. thuringiensis was very effective as a larvicide in controlling Cx. quinquefasciatus in pit latrines and cess pits in Dar es Salaam. It did not, however, have residual effects and will therefore require weekly applications, which may complicate antilarval operations (15).

Use of exit traps:

Easily constructed exit traps placed on pit latrine drop holes catch large numbers of mosquitoes (16). The efficiency of these traps is however greatly impaired by the rough surfaces of the existing latrine slabs. This could adversely affect community acceptance. The traps may, however, have a role to play in well built pits and in integrated vector control strategies.

Use of expanded polystyrene beads:

A suggestion has been made on the use of cheap and widely available expanded polystyrene beads as a layer on the water surface for mosquito control (17). The beads are light, biologically inert and non-biodegradable. Limited trials in Tanzania and Kenya showed dramatic declines in numbers of emerging young mosquitoes following treatment. A layer on a pit in Dar es Salaam made over two years ago is still intact. In pit latrines with a long drop, faeces pass through the bead layers which then reform immediately. This incidentally renders the latrines less offensive to users. The permanent elimination of pits as breeding sites may be viewed as a means of providing control teams more time to concentrate on other breeding sites such as keeping the drains clean and larviciding other breeding sites. The savings in the long run may be considerable. Plans are underway to undertake extended field trials in Dar es Salaam and Tanga.

Use of dry sanitary systems:

Since in coastal East Africa where the ground water table is high, pit latrines constitute the major source of Cx. quinquefasciatus breeding, the installation of pit latrines that do not reach down into the ground water table, would preclude mosquito breeding in such sites. Unfortunately mounted structures complicate construction and may not be afforded by the residents of poor periurban areas.

Double-vault compost latrines and the multrum (18) do not reach into the ground water even during the rainy season, and may therefore constitute plausible alternatives. In a previous field study in Dar es Salaam, these systems when properly used remained completely dry and therefore free of mosquito breeding for several years, although pit latrines, in the same area were wet.

CONCLUSIONS AND THE ROLE OF ENGINEERING TECHNOLOGY

The major Cx. quinquefasciatus breeding sites in coastal East Africa are pit latrines, soakage pits, cess pools, gully traps, septic tanks, drains, ditches and artificial containers. The Cx. quinquefasciatus problem is therefore man made and engineering technology must be employed in for example building latrines that do not breed mosquitoes even in high ground water-table areas, the timely repair of septic tanks and soak pits, the prevention of water pool formation, the correct disposal of sewage and sullage, the proper construction and maintenance of waste-water treatment sites, the installation of water reservoirs and containers with tight fitting lids, the drainage of run off water from stand pipes, and the early repair of leaking water supply systems. Engineering technology must also consider provision of such appropriate personal protection measures as housing that can be protected with wire gauze, and house lighting that minimizes mosquito resting inside houses.

Since engineers are a major cause of the Cx. quinquefasciatus problem, and have the knowhow in environmental control measures, they must also be major contributors in rescuing the desperate situation.

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