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A trial of insect traps for pit latrines in Dar es Salaam

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Insect breeding in pit latrines and insecticidal control

In the many areas where for the foreseeable future water borne sanitation will be too costly, the installation of pit latrines or other on-site sanitation systems has an important role in the struggle against various diseases which are transmitted via excreta such as cholera, typhoid and schistosomiasis. However, the installation of pit latrines can have the adverse side-effect of providing new breeding places for the mosquito Culex quinquefasciatus (Curtis and Feachem, 1981), which transmits filariasis in urban areas on the Tanzanian coast, and flies such as Chrysomya putoria, which are a menace to health because of their habit of flying from faeces to human food (Greenberg, 1973).

In Dar es Salaam, and some other towns in Tanzania, there is a municipal programme of spraying the insecticide chlorpyrifos (Dursban) into all pit latrines and cess pits. This is done every ten weeks following the work of Bang et al. (1975) which showed that in the early 1970's the residue left 10 weeks after a spraying continued to prevent breeding by Culex quinquefasciatus. However, more recently, a high degree of resistance to chlorpyrifos has been found to have evolved in the mosquito population of Dar es Salaam, Tanga, Morogoro and Zanzibar (Curtis and Pasteur, 1980). Though each round of spraying still greatly reduces the adult mosquito population, breeding of the present-day resistant population can begin 2-3 weeks after a spraying,

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so that breeding is only prevented for a fraction of the 10 week spraying cycle. The insecticide for each round of spraying in Dar es Salaam costs the equivalent of about TSh 200,000, payable in dollars, and in present circumstances an increased frequency and/or dosage of spraying to permanently prevent breeding seems out of the question.

The design and use of traps

Traps to catch mosquitoes flying out of rooms have long been used in mosquito research. The insects are attracted by light and/or fresh air entering through the netting on the outer side. They enter the trap through a tapering cone-shaped piece of netting and . . . it is difficult for them to find the narrow hole at the tip of the cone to escape (fig. 1). Thus the trap works on the same principle as a lobster trap. Our own work began with a rather cumbersome trap made of wood and wire netting (Curtis, 1980), but we then read a report of the work of Raybould (1966) who used traps made from empty paint containers on pit latrines in Amani and caught flies by the kilogram in this way. Using netting made of fibreglass coated with PVC (6.5 threads per cm), contact adhesive and used 4 litre metal or plastic paint containers (available from paint factories in Dar es Salaam) and baseplates made of scrap sheet metal bolted to the paint containers, satisfactory traps were made by staff of the Mosquito Control Department of the City Council of Dar es Salaam (fig. 1 and plate 1). The cost of the traps was about TSh 6-7 each. Before installing a trap over a pit latrine with raised footrests it is necessary to block the gap between these foot rests to prevent exit of insects, without preventing water running away. This can be done by suspending a piece of sheet metal so that it can swing, to allow water to flow, and fall back into place after the water has finished flowing (fig. 1 and plate 2).

The trap has to be moved by a latrine user and it is essential that it is put back after use. Small scale trials in 1980 suggested that traps were well received by householders and were replaced after latrine use (Curtis, 1980). Where there were heavy infestations of blowflies in latrines, householders expressed satisfaction with the easily visible large catches of flies in the traps and with the reduction in fly nuisance in their kitchens. Trapped mosquitoes and blowflies die within a few days. The dead mosquitoes are often carried away by ants but dead flies accumulate in the traps. When there are large catches of blowflies, the netting cone needs to be periodically turned inside out so that the dead flies can be emptied from the trap. The traps have proved very useful in research on the effectiveness of vent pipes on improved pit latrines as a possible means of solving the problem of insect pests from pit latrines (Curtis and Hawkins, 1982).

Covers for pit latrines have long been advocated as a means of controlling insects, but it seemed likely that traps would have advantages. Covers usually do not fit perfectly, thus not being proof against persistent insects, whereas with traps the insects were observed usually to take the obvious route into the traps without pausing to explore possible escape routes. From the point of view of user motivation, the effectiveness of traps in catching insects is readily seen, whereas, on the contrary, with covers a cloud of escaping insects may be seen on raising the cover. For these reasons it seemed worthwhile to carry out a trial of traps as an insect control method on an area-wide basis.

Area-wide trial of traps in Dar es Salaam

In 1981 a trial has been carried out by staff of the City Council on the impact on the density of adult insects in the area of the use of traps on insect infested pit latrines. The trial was in the Kariakoo district of Dar es Salaam in an area bounded by Msimbazi, Swahili, Mkunguni and Lumumba Streets and Morogoro Road. The area was about 400m x 250-450m and contained about 200 houses. A survey was carried out, using soup ladles, to find which of the pit latrines in this area contained fly or mosquito larvae. The results are shown in Table 1. Mosquito larvae require a free water surface but fly maggots were found both in pits with a free water surface and where it was covered with scum. Many pits have more than one aperture, so that more traps are required than the total number of infested pits.

For several years the City Council has monitored the densities of adult mosquitoes in the City by the standard technique of spraying certain designated houses with pyrethrum once a week and collecting the dead mosquitoes from sheets laid on the floor. The captures in 29 houses in central Ilala and 31 houses in peripheral parts of Ilala were used as controls for our experiment. Ten additional houses in the Kariakoo trial area were designated for weekly pyrethrum spraying. An attempt was also made to monitor the density of adult *Chrysomya putoria* blowflies, using traps in the compounds of the houses used for monitoring the mosquitoes. The traps were similar to those used on the latrines but were turned over and baited with fish offal. However, the catches in these traps were sporadic, ranging from many zeroes to one case of 200 and it did not appear that these gave a reliable index of blowfly densities.

Spraying of chlorpyrifos was suspended in the pit latrines in the Kariakoo trial area during 1981 but a spray was carried out in the control areas in April and this caused a temporary sharp reduction in the populations in these areas (fig. 2). Monitoring of the adult mosquito population proceeded until the end of June without the traps in place. Meanwhile the traps were made and the apertures of the infested pits were prepared for installation of traps by fixing the flaps of sheet metal between the footrests, as already described. In early July, 80 traps were installed on infested pits. A re-survey in August revealed 25 more apertures on infested pits and traps were added to these. By the end of the trial in October only 85 of the 105 traps were still present and in good condition.

Counts in 20 of the traps made in most weeks revealed that 200-500 females had been caught. The pyrethrum spray catches indicated almost no reduction in the populations in the houses in the period when the traps were in use compared with the pre-trapping period (fig. 2). However, over the months July-October the urban and suburban control areas in Ilala without traps both showed a 2-3 fold increase in mosquito population density. This suggests that, although the traps failed to suppress the mosquito population in Kariakoo, they may have prevented a rise which would otherwise have occurred. This argument depends on the comparability of the mosquito populations in the control and experimental areas. The very high peak in June in the Ilala control areas was not so marked in the Kariakoo experimental area and this casts doubt on the comparability of these mosquito populations. Thus we cannot be certain whether the July-October results really do show a beneficial effect of the traps.

Although we did not expect to eliminate adult mosquitoes from the trial area by the use of the traps, it was disappointing that the experiment did not more conclusively show population control by the traps. Possible explanations are (a) a large proportion of the emerging mosquitoes were not caught because of imperfect fitting of the traps or were escaping when the traps were moved by latrine users; (b) many mosquitoes were escaping because of incorrect replacement of traps by latrine users; (c) a large proportion of the Culex quinquefasciatus breeding was in sites other than pit latrines; (d) the adult population in the trial area was strongly influenced by immigration from outside. Further studies of the last point could be made by fitting traps on all infested latrines in a moderate sized township surrounded by countryside unsuitable for Cx quinquefasciatus breeding.

Acknowledgements

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Abstract

1. There is need for improved methods of control of the mosquitoes *Culex quinquefasciatus* and the blowfly *Chrysomya putoria* breeding in pit latrines. The present procedure of spraying chlorpyrifos (Dursban) is expensive in foreign currency and not as effective as it used to be because the mosquitoes have evolved a high degree of resistance.

2. Traps can be cheaply made from used paint containers and fibreglass netting. These can be fitted over the apertures of pit latrines to catch emerging insects. Preliminary small scale trials suggested that the traps were well received by householders and were replaced in position after using the latrine.

3. A trial was carried out in an area of about 200 houses in Dar es Salaam. The adult mosquito population was monitored by pyrethrum spray catches. The population in the experimental area showed no reduction following introduction of the traps, but in control areas without traps there was a 2-3 fold increase, suggesting that the traps prevented this seasonal increase in the experimental area.

4. Although the results of the trial were not conclusive, they were sufficiently encouraging to warrant further study of the reliability of replacement of the traps by the public, the efficiency of the traps in catching all the mosquitoes emerging through latrine apertures, and the proportion of the total *Cx quinquefasciatus* breeding which is in pit latrines. Further studies should be conducted where there is unlikely to be a large influx of mosquitoes into the experimental area from outside.

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Table 1. Results of the survey in February 1981 of pit latrines in the trial area.

Total no. of houses	194
Total no. pit latrines:	
wet (with free water surface)	130
dry (without free water surface)	62
Wet pits infested:	
with blowfly maggots only	30
with mosquito larvae only	31
with both mosquito and fly larvae	2
Dry pits infested	
with blowfly maggots	22
Total no. infested pits	85
No. of apertures of infested pits	139

Captions

Fig. 1	Diagram of the traps and methods of fitting them to pit latrine apertures.
Fig. 2	Pyrethrum spray catches of adult female mosquitoes in the experimental area and the control areas.
Plate 1	Constructing insect traps
Plate 2	A trap installed on one pit aperture and another aperture prepared for installation of a trap by fitting a swinging flap of metal to allow water to enter the pit between the footrests but to block the exits of insects by that route

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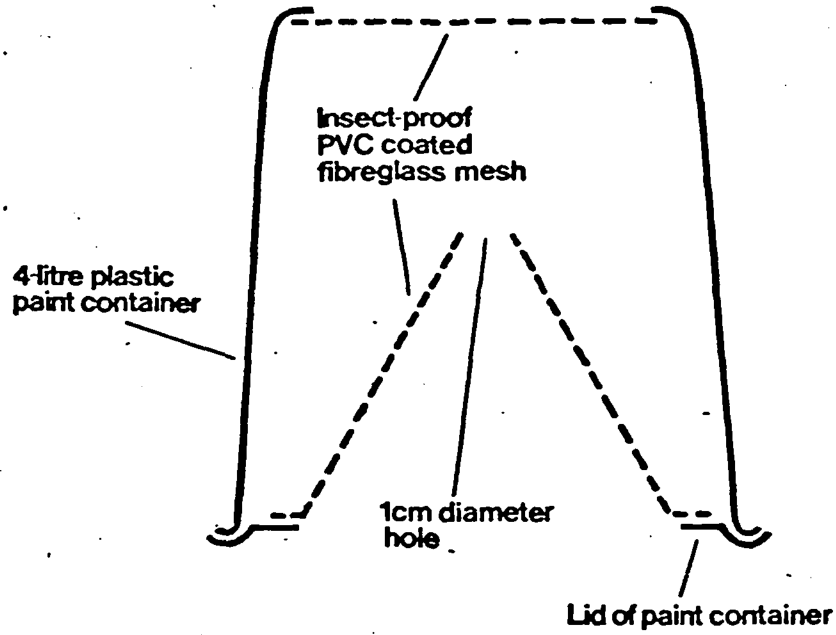
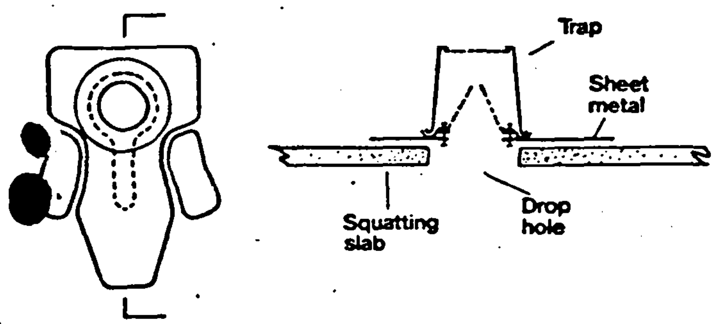
Cross section



Methods of fixing traps

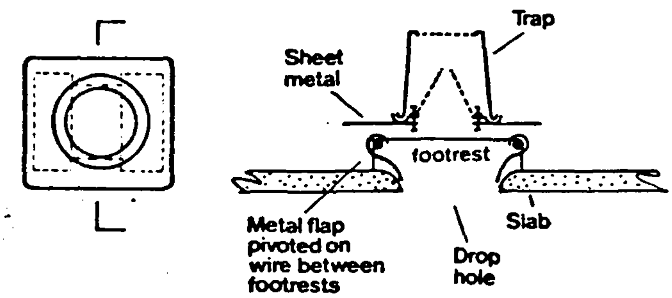
Over mass produced squatting plate

PLAN SECTION

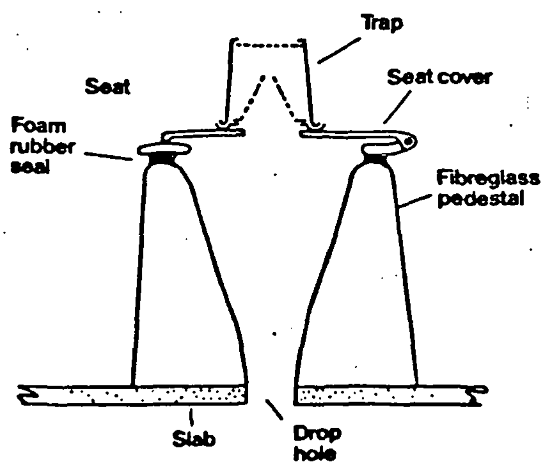


Over traditional squatting plate

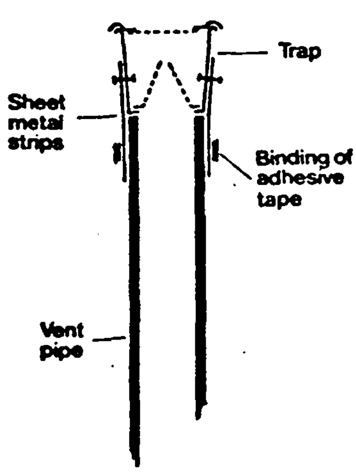
PLAN SECTION

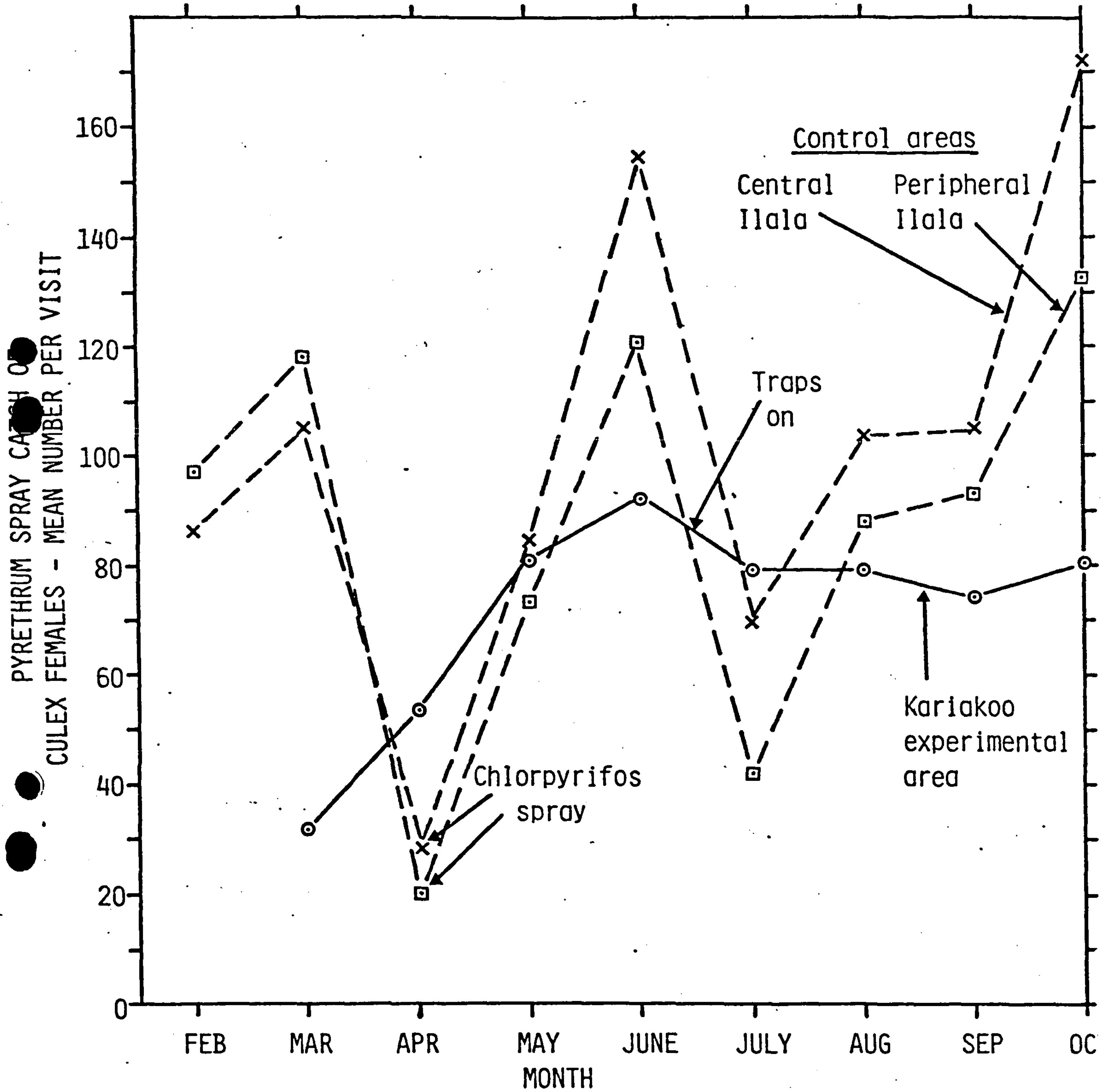


Over pedestal seat



On vent pipe





PYRETHRUM SPRAY CATCH OF
CULEX FEMALES - MEAN NUMBER PER VISIT
0
20
40
60
80
100
120
140
160
Control areas
Central
Ilala
Peripheral
Ilala
Traps
on
Chlorpyrifos
spray
Kariakoo
experimental
area
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEP
OC
MONTH

Fig ~