INDOOR RESTING HEIGHTS OF SOME ANOPHELINES IN COLOMBIA

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ABSTRACT. The nocturnal, indoor resting behavior of female anophelines in Colombia was studied. Anopheles darlingi and An. marajoara had a tendency to rest close to the ground, but An. oswaldoi and An. rangeli rested higher up. This behavior was independent of blooded status (except for An. oswaldoi) and whether the surface had been sprayed with DDT. With this information it should be possible to modify insecticide applications to coincide with the resting preferences of these species.

INTRODUCTION

In the national antimalarial program in Colombia, DDT is applied to the inner walls of huts. Potential vectors of malarial parasites resting on walls absorb a lethal dose and die. The insecticide is normally applied from the floor to the ceiling and on other indoor surfaces such as the underside of chairs, tables and beds.

Incomplete treatment of malarious areas (less than 30% since 1980) by the Colombian program is due, in part, to insufficient financial resources, personnel, equipment and increased operational costs. This situation has necessitated the search for alternatives that will reduce the quantity of insecticide used per hut, and allow greater geographic coverage without increasing costs. One possible approach would be for selective insecticide applications to those indoor surfaces where the anopheline mosquito rests, rather than indiscriminate treatment of all interior surfaces in the hut. However, any decision to modify existing treatment procedures must be based on entomological evidence obtained from studies of the indoor resting habits of malaria vectors.

The present study was undertaken to quantify the resting behavior of anopheline mosquitoes in 4 malarious regions of Colombia, and to evaluate the effect of spraying to a height of 1.5 m, compared with the normal spraying height of 3.0 m.

MATERIALS AND METHODS

This study was conducted in the departments of Bolivar, Santander, Meta and Caquetá. Two areas with a high incidence of malaria were selected in each region. Huts in one area were sprayed with DDT to a height of 1.5 m, whereas huts in the other were sprayed to 3.0 m. Two localities in each area were chosen for entomological evaluation.

Three persons were employed in the study by region. The first person, seated in a room of the hut, allowed mosquitoes to freely bite, fly and rest. The other 2 persons collected the resting female mosquitoes and recorded the height at which each mosquito was found, whether the resting surface had been sprayed with DDT, and if the anopheline was empty or engorged with blood. The mosquitoes were collected biweekly, in different houses between 1930 and 2330 h from 1985 to 1987 between February and November. Mosquitoes were stored individually and later identified to species.

RESULTS

When histograms were prepared for the numbers found on resting heights at 0.5 m intervals (Fig. 1), differences were found between the preferred resting heights of the 4 Anopheles species. Anopheles darlingi Root and An. marajoara Galvão and Damasceno both showed a tendency to rest at lower heights. In contrast, An. oswaldoi (Peryassui) and An. rangeli Gabaldon, Cova Garcia and Lopez tended to rest on the upper portions of walls.

When the numbers resting above and below the 1.5 m level were considered (Table 1), the differences from the null-point hypothesis of 50:50 above and below 1.5 m height were found to be highly significant for both the 2 low-resting species and the 2 high species, with chi-square values of 639.3, 53.6, 21.6 and 93.4, respectively, the P values all being less than 0.005. No statistically significant difference was found in the resting heights of engorged versus empty female An. darlingi, An. marajoara and An. rangeli. Although the resting heights of fed versus unfed An. oswaldoi were significantly different (x², P < 0.05, more unfed resting higher), both tended to rest higher than 1.5 m. The most frequent resting height of each species was independent of blooded status.

1 Opinions and assertions contained herein are the private views of the authors and do not necessarily reflect the view of the Colombian Ministry of Health.
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Likewise, the resting pattern for these species was also independent of DDT treatment (Table 2). Anopheles darlingi and An. marajoara showed a tendency to rest at lower heights (Fig. 1), whether the surface was sprayed up to 1.5 or 3.0 m. In the localities sprayed up to 1.5 m, a high proportion of An. rangeli and An. oswaldoi was found resting on surfaces without insecticide, consistent with the tendency of these species to rest above 1.5 m. In localities sprayed up to 3.0 m, a high proportion of these species rested on sprayed surfaces. Between 2.3 and 33.0% of the mosquitoes were found resting on surfaces that could not be sprayed such as paper, plastics, fabrics (bednets, clothes) metal and floors.

**DISCUSSION**

Each Anopheles species studied had a consistent resting pattern unaffected by feeding condition or insecticide spray on the walls. The tendency of An. darlingi to rest at low heights was previously reported in Belem, Brazil (Deane and Damasceno 1948), and in Colombia (Elliott 1972). However, in the Ituxi River region in Amazonas, Brazil, this species showed a tendency to rest on the ceiling, a behavior suggested as a regional difference by Roberts et al. (1987).

With the preferred resting heights observed for these species, effective selective insecticide application appears feasible. In regions where both An. darlingi and An. marajoara occur, it is possible to apply the insecticide from ground level up to 1.5 m high. In regions where An. rangeli and An. oswaldoi occur in significant numbers, it will be necessary to continue the routine procedure of applying insecticide to a height of 3.0 m on the walls.

However, it will be necessary to evaluate selective applications with epidemiological information. Selective insecticide applications have been successful in Italy and Yugoslavia, where the malaria vector An. maculipennis Meigen showed a tendency to rest above 1.5 m (Pampena 1966). Selective application has been proposed for the island of Java in Indonesia, where the vector An. aconitus Dönitz prefers to rest below 1.5 m (Damar et al. 1981).

Selective insecticide applications permit more efficient coverage by reducing the amount and time required for application. In regions where...
DDT is not desirable (e.g., because of DDT resistance), selective application would be even more advantageous because of the high cost of alternative insecticides. However, because regional differences in the resting behavior of each species are possible, it is always necessary to evaluate resting height preferences for each locality.

Although the majority of anophelines were found resting on sprayed surfaces in localities sprayed up to 3.0 m, some were found on non-sprayed surfaces, hence reducing the effectiveness of indoor spraying. This behavior justifies the necessity to carry out complementary control measures, like the use of bednets or curtains impregnated with permethrin or deltamethrin or repellents, in order to minimize man-mosquito contact.

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