

SUGGESTIONS FROM GRAVIDITY DATA OF CULICINES IN NORTHERN RHODESIA*

J. J. STEYN, PH.D., F.R.E.S., *Research Institute, Tzaneen, Transvaal*

INTRODUCTION

According to the Report of the Second Regional Conference on Malaria Eradication held at Addis Ababa in November 1959,⁴ it is considered that the bio-assay testing of insecticidal deposits usually furnishes inconclusive results, and new biological methods of evaluation should be worked out. In order to obtain a better insight into their spraying campaign against malaria vectors, Dr. F. A. Donnelly, O.B.E., M.B., Ch.B., D.P.H., Medical Officer of Health, Lusaka, and Mr. R. A. Mansfield, B.Sc. (Chem.), B.Sc. (Bact.), therefore decided to use the simplified gravity technique for determining physiological resistance to BHC.¹ They have kindly supplied the following information for publication.

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BHC APPLICATION

An average of 2 lb. of 75 % BHC, containing 10% of the gamma isomer diluted in 3 gallons of water, was used for spraying 1,000 square feet of hut walls and inner roof thatch. This is equivalent to about 75 mg. of active ingredient per square foot.

RESULTS

It is not possible to report at all regarding gravity of *Anopheles gambiae* Giles, for the control situation is such that no single adult *gambiae* or *A. funestus* Giles has been recovered in the municipal area of Lusaka during the past 2 years.

Our assessment of BHC residual effectiveness has, therefore, of necessity to be based on 2 factors, namely, the absence of malaria

vectors within the municipal area (although prevalent immediately outside the boundary), and the degree of culicine gravidity.

During the past rainy season — the summer of 1959-60 — 394 adult culicine mosquitoes from 3 African townships, which were considered representative, were examined. Data were as follows:

	Males		Females		Total females
	Unfed	Fed	Half-gravid	Fully gravid	
67	107	153	63	4	327

DISCUSSION

1. The total number of 394 culicines is considered too small to yield definite conclusions, especially since different species were probably present. Nevertheless, useful deductions may be made from the findings.

2. The presence of males shows that mosquito breeding occurs near the huts.

3. It is of interest that the sex ratio of mosquitoes is usually 1:1. Unsprayed and BHC-sprayed huts in the Transvaal had an anopheline sex ratio of 1 male:3.9 females, and 1 male:2.4 females respectively;² while in the present investigation the culicine sex ratio was 1 male : 4.9 females.

4. From the relatively great scarcity of fully gravid culicines we may conclude that physiological resistance to BHC was absent in culicines during the present investigation, since they were apparently killed by the BHC before becoming fully gravid.

5. The 4 fully gravid females were found just before the second round of residual spraying, i.e. 3 months after the initial spraying. This suggests that BHC remains effective for 3 months.

It must be mentioned, however, that *gambiae* gravidity data revealed that BHC remained effective for 6 months in Bantu huts in the Transvaal, since the first fully gravid *gambiae* females were only found during the 7th month after residual spraying.¹ Exceptions to this were encountered as follows:

(a) During the first month after spraying, 1 fully gravid *gambiae* was recovered from blankets hanging in the middle of a very small Bantu hut on the banks of the Limpopo, after it had been unoccupied for 1 week.

(b) Fully gravid *gambiae* were found within 7 weeks after spraying of huts with walls made solely from reeds.

6. In this investigation the ratio of unfed: fed and half-gravid females was 1:2.02. With anophelines in the Transvaal, this ratio was 1:0.8. This comparison suggests that the culicines were less susceptible to BHC than anophelines.

7. In research the old tenet that, unless one goes beyond the facts one never gets as far as the facts, applies. The discussion may therefore proceed as follows:

In unsprayed huts in the Transvaal it was originally discovered that *gambiae* matures her eggs indoors. In unsprayed earthen huts we found 80 unfed and 179 fed and gravid *gambiae*. We reasoned that if the female feeds and matures her eggs in 12 hours, gravidity would proceed thus: when gravidity is recorded between 10 a.m. and 4 p.m. we will find — first morning at 10 a.m. 1 unfed

female; that night she takes a blood meal at 6 p.m.; on the second morning at 6 a.m. she oviposits, and is again found as unfed at 10 a.m. If she therefore completes oogenesis in 12 hours, she will not be found as fed, or gravid. Similarly if she completes oogenesis in 24 hours, it was calculated that the ratio of unfed: fed and gravid females will be 1:1, but our ratio was actually 80:179 so that she must have matured her eggs in 2:2375 days.² This is a good correlation for data determined by other workers on *gambiae*.

In unsprayed huts we found 13 unfed and 130 fed, half-gravid and fully gravid *gambiae*. We reasoned that *gambiae* first rests in the hut before feeding, otherwise we would never have found unfed females, and we calculated that the female rests indoors for $2 \cdot 2375 \times 24 \times 13$

hours = 4.8818 hours before taking a blood meal.

143

This figure is useful since it is supported by Smith,³ who determined that 'the peak of fed *gambiae* occurs about 4 hours after the peak of the unfed, suggesting that there is a delay of about 4 hours between arrival at the enclosure wall and feeding'.

If, for the sake of analysis, we further assume that the present culicines behaved like *gambiae* in the Transvaal, we may tentatively conclude that a female becomes half gravid in 1.222 days.² Further, if we also assume that the BHC did not kill the culicines, then we would have $\frac{71}{13} \times 107 = 584.4$ fed and half-gravid in BHC huts.

We may therefore deduce that BHC might have 'knocked out'

the culicine females in $\frac{1 \cdot 222 \times 24 \times 216}{584.4}$ hours = 10.84 hours. This

also indicates that the culicines were less susceptible than *gambiae* to BHC.

SUMMARY

The simplified gravidity technique for determining physiological resistance to BHC,¹ was used in 3 African townships where huts were sprayed with this residual insecticide. The gravidity analysis suggests that BHC remained effective for 3 months, and that resistance was absent. Comparisons indicate that culicines are less susceptible than anophelines to BHC. Using Transvaal data,² it was calculated that female culicines were 'knocked out' in 10.84 hours.

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REFERENCES

1. Steyn, J. J., Brink, C. J. H., Botha, H. P., Pretorius, H. M. and Combrink, H. J. (1959): S. Afr. Med. J., 33, 172.
2. Steyn, J. J., Brink, C. J. H., Botha, H. P., Pretorius, H. M., Combrink, H. J. and Vosloo, A. (1959): *Ibid.*, 33, 679.
3. Smith, A. (1958): E. Afr. Med. J., 35, 559.
4. World Health Organization (1960): Regional Conference on Malaria Eradication held at Addis Ababa in November 1959. WHO/Mal/265, 20 May 1960.

(*This is from Steyn et al.;² 13 unfed and 71 fed and half-gravid *gambiae* females from unsprayed huts.)