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REPORT ON TRIALS ON AIRCRAFT DISINSECTIZATION IN WEST AFRICA

by

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Introduction

Series of experiments on disinsectization of aircraft were carried out at the Lagos Airport (Ikeja) in Nigeria during the period February-March 1950.

Two types of spraying equipment were used for comparative trials: (a) The Porton-Sparklet CO_2 propelled aerosol dispenser filled with Stafford and Allen's Insecticide R.587 and (b) the new Low Pressure Freon propelled aerosol dispenser developed by Messrs. Cooper Technical Bureau. The latter contained a formulation composed of 0.3% pyrethrins with an addition of piperonyl butoxide in petroleum distillate. (Formulation I)

All the trials were carried out during the peak of the "dry season". At Ikeja the monthly mean of daily maximum temperature in February is 91.0°F, the absolute maximum temperature 95.0°F, the monthly mean of daily minimum temperature is 72.6°F, the absolute minimum temperature 66.0°F. The mean relative humidity at 12.00 G.M.T. is 64.0%.

The tests were carried out in two types of aircraft: (a) De Havilland "Dove" used for communications within Nigeria or for communications with the neighbouring territories and (b) Bristol "Wayfarer" which is occasionally used for internal traffic, but mainly for inter-colonial trans-African communications like the newly opened line Lagos-Khartoum.

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* For reasons of economy, no translation made in French

The spraying tests using the "Dove" were carried out in six instances on landing at Ikeja when the aircraft carrying 5-8 passengers and on ten occasions when the plane was grounded and empty. The capacity of the Dove is 400 cubic feet.

The tests using the Wayfarer were carried out on two occasions after landing when the plane was carrying 12-20 passengers and cargo. The cubic capacity of the Wayfarer is 1700 cubic feet.

The species of female mosquitoes most important from the point of view of transmission of urban yellow fever or malaria were used for the purpose of these trials.

Females of A. aegypti were obtained from a laboratory colony; females of A. gambiae were obtained from a first generation of adults bred out from eggs of wild caught gravid A. gambiae gambiae and A. gambiae melas.

Of each species 25 females 48-72 hours of age and previously fed on sugar were confined in cages 6" x 7" x 8" size made of plastic gauze.

These cages were carried to the airport in a well protected box with a wet towel on top of it. In each test three or six cages were exposed.

In the closed aircraft the cages were disposed as follows: (a) In the cockpit on the pilot's seat, (b) In the main cabin on or under the seat, (c) In the tail-end of the aircraft, on the floor leaning against the door to the toilet.

The dosage of the insecticidal aerosol was measured by carrying the discharging container from the cockpit to the tail or vice-versa during a stated time.

According to David (1949) the performance of the Porton Sparklet dispenser is very uniform and averages 1 ml of insecticide per second. With the Allen's R.587 insecticide containing approximately 0.4 per cent pyrethrins a dose of 10 ml = 10 seconds per 1000 cubic feet of free aircraft space should be adequate to obtain a 100 per cent kill of mosquitoes. (Duguet 1949)

According to the manufacturers the Cooper Low Pressure aerosol dispenser discharges 1 gramme per second and a dose of 3-4 seconds should be sufficient to treat 1000 cubic feet of space.

In two preliminary trials where the Porton Sparklet and Low Pressure dispenser were used both at the rate of 2 seconds per 400 cubic feet capacity of a Dove (corresponding with the dosage of approximately 5 ml per 1000 cubic feet) the knock down and the kill of mosquitoes were very erratic and the latter often below 50 per cent.

After these preliminary trials a higher aerosol dosage was substituted. This higher dosage was 5 seconds per 400 cubic feet capacity of a "Dove" or 12.5 seconds per 1000 cubic feet of free space.

During the first three trials on grounded "Dove" the aircraft was left closed for 10 minutes after spraying. After this time lapsed the cages were inspected, the results of the knock-down recorded and the cages were removed to the laboratory for determination of the percentage of the kill after 24 hours.

Thereafter, following the actual procedure as carried out at most of the West African airports the aircraft was left closed for 3 minutes only, after which time the doors were opened and the cages left in the aircraft for another 10 minutes.

Controls run with A. aegypti or A. gambiae never gave a higher mortality after 24 hours than 25 per cent.

The results of the trials are shown in the following table separately for each type of the aircraft and for the dosage.

Table 1
Results of trials carried out in "Dove" aircraft with two types of aerosol dispensers

(Dosage: 5 seconds per aircraft of 400 cubic feet capacity or approximately 12.0 seconds per 1000 cubic feet)

	Porton Sparklet dispenser Insecticides Allen's R587				Cooper Low Pressure dispenser Formulation I			
Trial	A. aegypti P.c.		A. gambiae P.c.		A. aegypti P.c.		A. gambiae P.c.	
	K.D.	Kill	K.D.	Kill	K.D.	Kill	K.D.	Kill
1	65	100	-	-	63	98	-	-
2	65	98	73	100	65	94	77	100
3	71	90	-	-	71	100	-	-
4	37	80	-	-	65	100	-	-
5	46	70	69	91	50	91	91	100
6	40	75	46	89	29	89	75	96
Total	54	85	63	94	57	95	81	99

Note: In the last three trials the doors of the aircraft were opened 3 minutes after spraying. The decrease of the rate of knock down and kill is very noticeable particularly for A. aegypti.

There was a notable difference in the K.D. and Kill (after 24 hours) between batches of mosquitoes in cages placed in the cockpit, in the middle of the cabin or near the tail of the aircraft.

This is shown in the following table which refers to A. aegypti killed

during the trials 4, 5 and 6.

	Porton Sparklet dispenser			Low Pressure dispenser		
	Position of cages with mosquitoes			Position of cages with mosquitoes		
	Front	Middle	Tail	Front	Middle	Tail
Per cent of total kill	42%	38%	20%	38%	36%	30%

This became particularly obvious during the trials carried out in "Doves" landing in Lagos, after an actual flight when because of the heat and not too good ventilation of the small aircraft on the ground it became imperative to open the door and to let the passengers disemplane not later than 3 minutes after spraying.

There is little doubt that the early opening of the door causes an updraught of fresher and cooler air and interferes with the dispersion of the aerosol the toxic aerosol concentration in this particular part of the aircraft.

A higher dosage of the same insecticidal aerosols was tried on four occasions on A. aegypti in grounded "Dove" without any change of the previously described aerosols or the minute preventilation time. The dose applied in this case was 10 seconds per 400 cubic feet of the capacity of the "Dove" corresponding to 25 seconds per 1000 cubic feet and gave the following results:

Table 2
Results of trials carried out in a "Dove" aircraft with two types of aerosol dispensers

(Dosage: 10 seconds per aircraft of 400 cubic feet capacity corresponding to 25 seconds per 1000 cubic feet of free space. Test insects: Females of A. aegypti)

	Porton Sparklet		Cooper Low Pressure dispenser	
Trial	K.D.	Kill	K.D.	Kill
7	81	100	83	100
8	85	100	90	100

Two trials with A. aegypti were carried out in Bristol "Wayfarer" aircraft returning with passengers and cargo. This aircraft has a cubic capacity of approximately 1700 cubic feet and a 30 seconds dosage of the two insecticidal aerosols was given in each case with 3 minute preventilation period. This dosage is slightly higher than the draft regulation WHO dosage of 15 seconds per 1000 cubic feet. The results were as follows:

Table 3
Results of trial carried out in a Bristol "Wayfarer" aircraft with two types of insecticidal aerosol

(Dosage: 18 seconds per 1000 cubic feet. Test insect: A. aegypti)

	Porton Sparklet dispenser Insecticide: Allen's R.587		Cooper Low Pressure dispenser Cooper's Formulation I	
	K.D.	Kill	K.D.	Kill
Trial Exp. 9 & 10	95	100	90	100

Discussion

Series of comparative trials carried out at tropical airport in two types of aircraft (De Havilland "Dove" and Bristol "Wayfarer) by means of two types of aerosol dispensers: (a) Porton Sparklet CO_2 propelled dispenser filled with Allen's R.587 insecticide containing approximately 0.4 per cent pyrethrins and (b) Cooper Low Pressure Freon propelled dispenser filled with a formulation containing 0.3 per cent pyrethrins have brought up the following points.

At a dosage of 2 seconds per "Dove" (5 seconds per 1000 cubic feet or approximately 0.02 gm of pyrethrins per 1000 cubic feet) both aerosols show a very erratic knock down and a poor kill of A. aegypti often below 50 per cent.

At a dose of 5 seconds per "Dove" (12 seconds per 1000 cubic feet or approximately 0.04 to 0.05 gm of pyrethrins per 1000 cubic feet) both aerosols gave a 100 p.c. kill of A. gambiae but the kill of A. aegypti varied between 90.0 and 100.0 per cent. The aerosol produced by Cooper's Low Pressure dispenser gave a better dispersion a substantially higher kill than that produced by the Porton Sparklet dispenser.

This became particularly obvious when the time of exposure to the aerosols was cut down from 10 minutes (in empty aircraft) to 3 minutes (in passenger carrying aircraft).

Series of tests on mosquito cages placed in various parts of the aircraft ("Dove") have shown that the lowest K.D. and the lowest kill are seen in mosquitoes placed near the tail end close to the door which ventilates the aircraft after spraying.

Doses of 10 seconds per "Dove" (25 seconds per 1000 cubic feet or approximately 0.8 to 0.1 gm of pyrethrins per 1000 cubic feet) administered by means of the two dispensers gave in each case a high knock down and a 100 p.c. kill of A. aegypti.

In the Bristol "Wayfarer" both aerosols administered at a dose of 30 seconds (approximately 18 seconds per 1000 cubic feet or 0.06 to 0.07 gm of pyrethrins) with a 10 minute time of exposure gave a 100 per cent kill of A. aegypti.

In conclusion it seems that the Cooper Low Pressure aerosol dispenser filled with Formulation I compares favourably with the Porton Sparklet CO_2 propelled dispenser filled with Allen's insecticide R.587 and gives in otherwise similar condition a slightly higher knock down rate and a higher kill of A. aegypti and A. gambiae. It also seems to produce a finer and more dispersed aerosol. In the conditions described above the minimum effective rate of application of the two aerosols is 12.0 seconds per 1000 cubic feet of free space (0.04 to 0.05 gm of pyrethrins providing that the period of exposure of mosquitoes to the aerosol is 10 minutes.) Higher doses are much more effective and require a shorter (3 minutes) period of exposure, but are often irritating to the respiratory tract of passengers and crews. This is particularly noticeable with respect to the Cooper's formulation I. It is doubtful if this formulation would be acceptable to the passengers if applied at the dosage advocated by Duguet (1949) of 25 gms per 1000 cubic feet.

In order to limit concentration of the active principle of the insecticide to the acceptable and economical minimum the period of exposure to the aerosol is often increased to at least 10 minutes. This might be possible in laboratory experiments or in temperate climates but cannot be enforced in tropical areas, without causing a considerable discomfort to the passengers and crews.

It must be remembered that an aircraft standing in the full blast of the sun on the concourse in a tropical airport receives an enormous amount of radiated heat from the black tarmac and that the main cabin inside a non-ventilated aircraft soon becomes most uncomfortable.

At the Lagos Airport in February at 10.00 a.m. the microclimate of the passengers cabin of the "Dove" standing on the concourse was as follows: (a) Temperature in the shade 97°F; (b) Temperature on the sunny side 105°F; (c) Humidity 60%.

This microclimate is exceedingly uncomfortable and can hardly be inflicted for as long as 10 minutes on passengers especially after 3 - 5 hours of flying. It seems that the procedure adopted of necessity by the airport personnel namely 3 minutes interval between spraying and opening the doors is reasonable as far as the human factor is concerned.

However, this short exposure time should be coupled with an increased dosage

of at least 15 gms of a standard insecticide aerosol per 1000 cubic feet or even 25 gms per 1000 cubic feet as advocated by Duguet (1949).

This creates new problems of discomfort to the passengers on account of high concentration of the aerosol. It also increases very considerably the cost of the spraying procedure since most of the modern airliners have as much as 4000 cubic feet capacity.

It seems that the ideal method of disinsectization of aircraft, a method complying with all the requirements as listed by Duguet (1949) and applicable to all climatic conditions is still awaiting to be worked out.

Conclusions

1. Trials carried out at the Ikega Airport (Lagos, Nigeria) by means of two aerosol dispensers have shown that a new Low Pressure Freon propelled dispenser filled with a 0.3 per cent pyrethrins formulation compares favourably with the Porton Sparklet CO_2 propelled dispenser filled with a standard insecticide. The adequate dose was found to be at least 0.08 gms pyrethrins per 1000 cubic feet.

2. Anopheles gambiae are somewhat more sensitive to the tested formulations than Aedes aegypti.

3. There was a lower rate of kill of mosquitoes confined in cages standing near the ventilating door.

4. The necessity of shortening the usually advocated 5 or 10 minutes exposure time to a maximum of 3 minutes is emphasized with regard to the microclimate of aircraft in tropical airports.

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