

RESISTANCE OF THE BODY LOUSE (*PEDICULUS HUMANUS CORPORIS* DE G.) TO DDT POWDERS*

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Reports from numerous countries throughout the world have indicated that DDT powders are apparently no longer giving adequate control of the body louse. This suggests that this insect pest has possibly developed resistance to DDT, just like the house fly, which was previously adequately controlled by this insecticide. As resistance is a serious public-health problem, the World Health Organization's Division of Environmental Sanitation has arranged body-lice resistance tests with standardized kit forwarded from Geneva. The present investigations were conducted at Queenstown, Cape Province, and neighbouring areas as part of the global survey.

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In 1954 and 1958 the powders from the standard WHO kit for determining the resistance of the body louse were used on cloth according to the kit instructions.

In 1956, at Queenstown, Dr. Carroll N. Smith, Entomology Research Division, US Department of Agriculture, Florida, confirmed our 1954 results. In addition to the WHO powder test kit, he used cloth pads impregnated with acetone solutions of insecticides for beaker tests as described by Eddy.¹

Lice were tested from the Bantu locations not only of Queenstown but also of Eskeaton, Macibini, Qoqodala and Mtyantya, in the Queenstown area. This was done in order to obtain a clearer insight into the local problem, since less DDT had been used in these neighbouring locations than in the Queenstown location. The average percentage resistance of lice from individual areas is shown in Table I. Only lice

TABLE I. AVERAGE PERCENTAGE RESISTANCE TO INSECTICIDE POWDERS

Concentration of toxicant in powder	1954				1956	1958		
	Queenstown		Eskeaton	Macibini	Queens- town	Qoqodala	Matyan- tya	Queens- town
	Series 1	Series 3	Series 2	Series 4	Series 1	Series 1	Series 2	Series 3
0.04% DDT	—	—	—	—	81.7	43.3	39.8	—
0.1% DDT	67.5	60.0	54.2	35.0	—	—	—	33.3
0.2% DDT	—	—	—	—	71.7	36.7	43.3	—
0.5% DDT	52.5	12.5	49.4	2.5	—	—	—	40.0
1.0% DDT	71.7	38.8	76.7	12.5	75.0	6.7	10.0	33.3
5.0% DDT	81.7	28.8	56.7	5.0	43.3	0	0	25.0
0.02% gamma BHC	—	—	—	—	46.7	13.3	0	—
0.1% gamma BHC	—	—	—	—	26.7	—	—	—
0.25% gamma BHC	0	0	0	0	—	—	—	0
0.5% gamma BHC	0	0	0	0	0	—	—	0
2.5% gamma BHC	—	—	—	—	0	0	0	—
0.0016% pyrethrins	—	—	—	—	21.7	0	6.7	—
0.008% pyrethrins	—	—	—	—	8.3	—	—	—
0.02% pyrethrins	0	0	0	0	—	—	—	0
0.04% pyrethrins	0	0	0	0	0	—	—	0
0.2% pyrethrins	—	—	—	—	0	0	0	—
Controls normal	95.8%	100%	100%	100%	100%	93.3%	90.0%	100%
Average temperature	17.3°C	25.1°C	16.0°C	25.1°C	24.7°C	26.9°C	25.5°C	26.4°C
Average rel. humidity	—	—	—	—	—	38.5%	42.4%	40.0%

which appeared normal after 24 hours' exposure, were scored as resistant. Since 1954 some of the concentrations of insecticides provided in the test kit have been altered or added; hence the blanks in Table I. Replicates were run as specified in the kit instructions and the average percentage resistance calculated.

COMMENTS

Queenstown Location

From June 1952 until November 1956 10% DDT in talc was regularly used at intervals of 6 weeks for dusting premises, persons and clothing against louse-borne typhus in this Bantu location. After November 1956 0.6% lindane was employed selectively on persons and clothing found infested.

1954. For series 1 (1954) lice were obtained from an old invalid Bantu woman who continued to be infested in spite of repeated de-verminization between the regular 6-weekly dustings. Her lice were found to be 81.7% resistant to 5% DDT powder. (It is of interest to mention that the Bantu woman who always tended this invalid was carefully searched and no lice were found on her person or clothing, although she always slept in the same room as the invalid. All occupants slept on the floor.)

For series 3 (1954) lice were obtained from a Bantu male. These were less resistant than the lice in Series 1 (1954).

Commenting on the 1954 tests the following statement was published in the *Chronicle of the World Health Organization*:² 'Two samples from the African township of Queenstown and Eskeaton, Union of South Africa, with mortalities of 18% and 14% respectively, were the most resistant strains encountered in the survey, even surpassing those from Korea in this respect.'

1956. Commenting on series 1 (1956) Smith³ stated: 'The dust tests indicated a high resistance to DDT, and the beaker tests showed the degree of resistance to be in the neighbourhood of 130 times normal. There was little or no resistance to lindane . . .'

1958. At Queenstown location in July-August 1958. Kit prepared in February 1954 had to be used for series 3 (1958). (Fortunately kit prepared in June 1957 was available for the 1958 tests at Qoqodala and Matyantya.)

Resistance to DDT as shown by series 3 (1958) was consistently lower than the Queenstown values during 1954 and 1956 (except for the 0.5% DDT figure in series 3 (1954)). Resistance to 1.0% DDT was respectively 5 times and 3.3 times as high as in Qoqodala and Matyantya. Resistance to 5.0% DDT was 25.0%.

Eskeaton Location, 1954

Since the Bantu came to know of the usefulness of DDT as an insecticide, which was about 1948, they have been buying it in small quantities from traders for private use. It has not, however, been used on a large scale.

From 1949 to 1954 only sporadic typhus outbreaks occurred in this area. DDT dusting by the Government Health Department was confined only to spots where outbreaks actually occurred. All contacts were traced and dusted to quell the outbreaks and to stop further spread of the disease. Except for these outbreaks no large-scale control measures were carried out.

The very high resistance values found at Eskeaton in series 2 (1954) are of interest especially because relatively

little DDT had been used in Eskeaton location as compared to the Queenstown location.

Macibini Location, 1954

This area is not densely populated and huts are scattered. This location is in the Glen Grey district, which was an endemic plague area, and dusting campaigns with 10% DDT had been carried out by the Government Health Department throughout this district to suppress plague outbreaks. The last campaign was conducted in 1949. Since then some of the Bantu have been buying DDT themselves, but some kraals have not yet used this insecticide.

Table I shows that in 1954 DDT resistance in this location was markedly lower than at Queenstown and Eskeaton locations.

Qoqodala Location 1958

DDT has not been used for lice control in this location. It is thus instructive that Table I shows a markedly and consistently lower DDT resistance in 1958 at Qoqodala than that found in the DDT-controlled Queenstown location during 1954 and 1956. Of special interest is the complete absence of resistance to 5.0% DDT.

The resistance to 0.02% gamma BHC was 13.3%.

Matyantya Location, 1958

As at Qoqodala, DDT has not been used for lice control in Matyantya location, and Table I discloses in Matyantya, as in Qoqodala, a markedly and consistently lower DDT resistance than in the DDT-controlled Queenstown location during 1954 and 1956.

There was 10.0% resistance to 1.0% DDT, no resistance to 5.0% DDT, none to 0.02% gamma BHC, and 6.7% resistance to 0.0016% pyrethrins.

EFFICIENT DUSTING

In September 1954, when the highest DDT resistance was found in Queenstown lice from the old Bantu invalid who remained infested in spite of repeated de-verminization between the regular 6-weekly dusting, we reported: 'After collection of test lice material . . . , the premises, consisting of 2 rooms, together with all bedding and clothing and 3 occupants, were thoroughly dusted with 10% DDT in talc by members of the Field Staff of the Government Health Department. After 24 hours all lice were dead except 2 paralysed ones. Eight subsequent daily observations revealed no live lice on the premises.'

This finding shows that in 1954 the Queenstown lice, which had the highest DDT resistance of all lice tested with WHO kit in about 100 parts of the world, were 100% controlled and completely killed by proper and efficient application of 10% DDT powder.

We further stated: 'Field Assistant J. G. Greeff reported that "people who were de-verminized with 10% DDT powder on 15 July 1958 were again searched for lice on 17 July 1958, but not a single louse was seen". This information refers to that part of Qoqodala location in which DDT was previously used, and shows that if properly applied, DDT still gives a 100% kill.'

SUGGESTIONS FOR FUTURE TESTS

Experimental Dusting to Support Test-kit Data

As the South African lice were the most resistant of all lice tested with WHO kit in about 100 different parts of

the world, and as we still obtained a 100% kill by proper application of DDT powder, we would like to suggest that future tests with WHO kit might consistently be supplemented by thorough experimental dusting of 2 or 3 premises and the occupants as well as their clothing. This will not only yield information on resistance, but will also show the relative efficacy of DDT when properly applied.

Every experienced entomologist knows that what happens in laboratory tests is not always repeated in the field. At Letaba,⁴ where we doubled the commercial value of the citrus crop in certain experimental plots by keeping ants out of the trees, we found a 100% kill of red scale on oranges which were sprayed with DDT + Avon oil; but when a few trees were similarly sprayed, red scale reproduced so prolifically that the trees defoliated because natural scale enemies were exterminated.

Gravidity Data to Supplement Busvine Tests

Following the Queenstown and Letaba considerations, we have further developed a simplified gravidity technique for detecting physiological resistance of *Anopheles gambiae* Giles to BHC in the field during malaria eradication campaigns,⁵ because resistance results determined in a laboratory test might be different from resistance under field conditions which might affect eradication procedures.

Resistance of Immature Lice

It might be of practical value to obtain information on the relative resistance of immature and mature body lice, since a more complete insight into resistance will effect better control.

SUMMARY

1. The resistance of body lice was determined with the WHO test kit at Queenstown and neighbouring areas.

2. In September 1954 resistance to 5.0% DDT powder at the Queenstown location, where DDT had been regularly used at 6-weekly intervals for typhus control since June 1952, Eskatoon location, where less DDT had been used, and Macibini location, where still less DDT had been used, was respectively 81.7, 56.7 and 5.0%.

3. In November 1956 Dr. C. N. Smith, of Florida, USA, confirmed our 1954 data and found that DDT resistance was in the neighbourhood of 130 times the normal.

4. In August 1958 in Qoqodala location, where DDT had not been used for lice control, resistance to 1.0% DDT, 5% DDT and 0.02% gamma BHC was respectively 6.7%, 0% and 13.3%. At Matyantya location, where DDT had similarly not been used, resistance to 1% DDT, 5% DDT, 0.02% gamma BHC and 0.0016% pyrethrins was respectively 10.0%, 0%, 0% and 6.7%.

5. As the Queenstown lice were the most resistant of all lice tested, but were still 100% killed by proper application of 10% DDT, it is suggested that experimental dusting of 2 or 3 premises as well as the occupants and their clothing should be carried out to supplement future tests with the WHO test kit.

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