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ADDITIONAL STUDIES OF CHEMICALLY TREATED CLOTHING FOR PERSONNEL--ETC(U)
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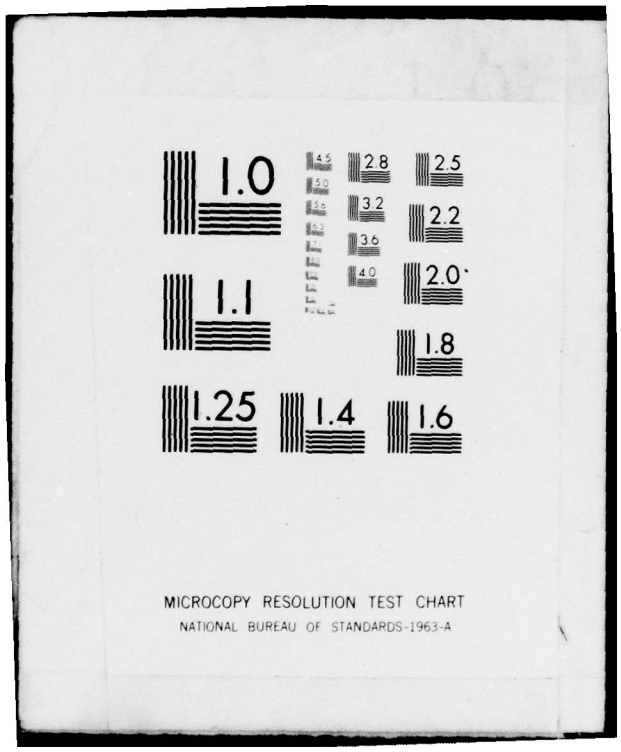
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DEFENCE RESEARCH ESTABLISHMENT OTTAWA

(7) TECHNICAL NOTE NO. 79-28

(6) ADDITIONAL STUDIES OF CHEMICALLY TREATED CLOTHING FOR PERSONNEL PROTECTION FROM BITING FLIES.

by

(10) I. S. Lindsay, B. Farnworth and R. Osczevski
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(14) DREO-TN-79-28

(12) 24

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(11) NOVEMBER 1979
OTTAWA

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ABSTRACT

Combat clothing and wide-mesh hoods treated with the insecticide permethrin have been evaluated for protection against biting flies. Experiments on human subjects indicate excellent protection against mosquitoes from both the clothing and the hoods. Experiments on plastic heads baited with dry-ice indicate moderate protection against blackflies from the hoods whereas the deet treated hoods gave excellent protection to the uncovered face.

diethyltoluamide

RÉSUMÉ

Ses vêtements de combat et les voiles en filet à grandes mailles imprégnés d'insecticide "permethrin" ont été évalués pour le protection contre les moustiques et les mouches noirs. Ses tests effectués avec des hommes, ont révété que la protection contre les moustiques est excellente dans les deux cas, i.e., les vêtements et les voiles. Par ailleurs, les voiles ont avantage à être utilisée avec de la glace séche contenue dans des têtes de plastique. La protection contre les mouches noires est alors modérée si les voiles sont imprégnés avec permethrin mais excellent avec l'insectifuge, diethyltoluamide.

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INTRODUCTION

Since 1975 five reports (1, 2, 3, 4 & 5) have been produced on studies of chemically treated clothing components for the protection of Canadian Forces (CF) personnel from the bites of mosquitoes and blackflies. These items, which were either jackets (6, 7, 8 & 9) with attached open face hoods (Figure I)* or separate open face hoods, (Figure II)* were made from a US-developed open-mesh textile[a] which contained polyester filaments in the warp for strength and abrasion resistance, and cotton in the weft for the absorption of the chemical. The jackets that were assessed in 1975 were supplied by the US Navy but subsequent test items were fabricated at DREO. In 1975 the items were treated with biting-fly repellent (diethyl toluamide) but in 1977 and 1978 the test clothing was treated with either diethyltoluamide (deet) or an insecticide (permethrin).

The following are the conclusions in the three of the previous reports:

a) 1975;

1. The USA prototype overgarment, treated with 0.25 g deet/g fabric, is effective in protection the wearer from several species of mosquitoes (Culicidae) and blackflies (Simuliidae).

2. Some species of deerflies and horseflies (Tabanidae) landed and remained on the surface of the treated jackets for significant periods but few bites were recorded by the wearers.

3. The garments were particularly useful for field personnel in static situations.

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[a] Textile netting, S-16Z4
Polylox Corp., New York, N.Y.

* Figures on pages 13 and 14.

4. Although the mesh material occasionally caught and tore on vegetation and equipment, the jackets seemed to retain their insect protective characteristic.

5. The wearing of the treated jackets did not significantly prevent body heat dissipation in active personnel.

6. Of the two deet concentrations used on test jackets, the 0.25 g/g of fabric appeared to give good insect protection and showed less tendency to "sweat" on to the wearer's under-garment than the 0.5 g/g.

b) 1977;

1. Jackets treated with the insecticide, permethrin, provided personnel with good protection against biting flies but, based on overall landing counts, were not as effective as jackets treated with deet, especially for protecting the face during initial exposure to the biting fly population.

2. The insecticidal action of permethrin-treated jackets reduced the biting fly population in the vicinity of the jacket to much lower levels after approximately 10 minutes exposure after which effective protection was afforded.

3. Both blackfly and mosquito adults were affected by the permethrin treatment.

4. When using permethrin as a jacket impregnant, the amount of chemical required to provide good protection is less than one-third by weight that required when using deet or other repellents.

5. Wide-mesh hoods treated with deet were as effective as jackets treated with deet or tetrahydrofurfuryl octanoate in providing protection to the facial area.

c) 1978;

1. It is confirmed that:

   a) permethrin-treated jackets with hoods will provide an acceptable level of protection to the wearer against the species of blackflies and mosquitoes that were present during the field studies.

   b) initially, at least, the permethrin-treated hoods do not give the level of face protection against biting flies that deet-repellent-treated hoods will.

2. Although the results gave an indication of small-area biting-fly control when the subjects wore permethrin-jacket-hoods, larger numbers of subjects and larger experimental areas are needed to provide reasonable evidence.

3. Separate deet-treated hoods, when worn with insect-bite-proof clothing, provide excellent protection to the wearer's face from mosquito and blackfly bites.

In late 1978 we were informed that a preliminary study of permethrin applied to standard clothing, rather than the mesh jackets, in the US (10) had been promising and comparative data for Canadian species of blackflies and mosquitoes would be useful.

The 1979 field investigations consisted;

a) A comparison of deet-treated open-face hoods (deet-hoods) and permethrin-treated open-face hoods (perm-hoods) for face protection of the wearer.

b) An assessment of untreated CF summer field clothing and permethrin-treated field clothing.

EXPERIMENTAL

The 1979 field evaluations were conducted at two sites, the Stoney Swamp area near DREO (mosquitoes) and in the Gatineau Park, Quebec (blackflies and mosquitoes). The test team varied from four to six persons. The majority of the assessments were performed with two control and two to four test subjects. As in 1978, most of the tests consisted of the following routine;

1) Subjects were transported to a site and were issued appropriate test items. All personnel wore untreated gloves during the tests.

2) The subjects usually sat in prearranged pairs for a period of time, but sometimes singly, and each subject recorded the number of insect landings which occurred on the face and hands of his partner using two hand-held counters or, if alone, himself. A landing was defined as one in which an insect alighted and began to probe or bite. When testing permethrin-treated jackets, landing counts were taken on the face and front portion of the jacket from neck to waist but excluding the sleeves.

3) A rotation of subject position occurred. This rotation was followed by a second session of sitting in groups and recording insect landings.

4) Insect specimens which landed on subjects were collected using an aspirator. Appendix A lists the identifications.

5) At the conclusion of the test, all equipment was collected and the subjects were transported from the site.

Occasionally, the mosquito or blackfly population levels at the test sites were marginal for giving significant data using human test subjects. A screening technique was devised, particularly for the comparative separate hood assessments, in which plastic heads instead of live subjects were used. The heads were painted with blue enamel and during the tests a depression of the top of each head was filled with a quantity of dry ice as a CO_2 source (Figure III). The forehead and cheeks of the heads were covered with removable, adhesive coated, tape so that any mosquitoes or blackflies which landed on the face were retained.

During the tests the heads wore the experimental or control head nets. Insect counts on the adhesive tapes were taken every ten minutes for thirty minutes. Six heads were used, two as controls. This method was not considered to be a replacement for the use of human test subjects. It was principally a screening technique when the insect population levels were relatively low and also provided complementary data. Except for the assessments of the two-piece CF summer field uniform (Figure IV), the basic clothing for the test subjects included dark green coveralls and cotton gloves. The coveralls were loose fitting and of relatively tightly woven material so were almost insect bite-proof.

The first series of tests was designed to compare the effectiveness of the open-face deet-hoods and the perm-hoods. In test number one the six plastic heads with added dry ice were used to compare the repellency of the deet-hoods, the perm-hoods and the untreated controls to blackflies and mosquitoes. The pairs of heads were located about fifty feet apart (Sites A, B and C) with one of each pair facing north and the others pointing south. Figure III shows one of the pairs. The prevailing breeze of 7 kph was from the NNW, the air temperature was 28°C and the RH was 70%. Following the first insect counts after 30 minutes on the adhesive surfaces, each head was rotated 180°. After another 30 minute count the site A heads were changed to site B, and site B to site C and the site C to site A. Again, two 30-minute insect counts were taken, with the heads being rotated 180° after the first one. Then the final site change was made and the insect counts continued. The results are shown in Table I. It was interesting to note that when the plastic heads were faced into the prevailing breeze much lower numbers of insects were trapped by the adhesive than when the heads faced downwind.

In the remaining tests of this series human subjects were used. Unfortunately, the weather became wet and windy for much of the time so mosquito and blackfly populations were generally low. Those data which were obtained are given in Table II and III.

Again, because of the weather, only one test was conducted on the comparison of the permethrin-treated and untreated CF summer combat clothing. Six subjects were involved, three with treated uniforms and three with untreated. All wore the old style headnets rather than the new hoods. The results of a short test done at Pink Lake against mosquitoes are shown in Table IV.

Table I

Blackfly Accumulations*on Adhesive Surfaces of Plastic Heads with Hoods, Black Lake

Time in minutes	P_1	P_2	D_1	D_2	C_1	C_2	Remarks
30	4	0	0	2	0	7	Heads rotated 180° after counts.
60	4	2	0	2	4	8	Heads rotated 180° after counts.
90	14	3	0	2	5	42	Head site changed.
120	16	3	0	3	6	48	Heads rotated 180° after counts.
150	16	8	0	3	13	50	Head site changed.
180	20	15	2	3	23	52	Wind increased, test terminated.

Legend P_1,P_2 Permethrin-treated hoods

D_1,D_2 Diethyltoluamide-treated hoods

C_1,C_2 Untreated hoods

* Simuluim venustum, (Say)

Table II

Blackfly and Mosquito Accumulations* on Faces of Human Subjects with Hoods, Black Lake

Time in minutes	P_1	P_2	D_1	D_2	C_1	C_2	Insects
30	1	0	0	0	4	6	M
	1	1	1	3	24	12	B
60	2	0	0	0	6	10	M
	6	2	2	3	26	17	B
90	2	0	0	0	6	14	M
	6	2	2	5	27	26	B

Legend

P_1,P_2 Permethrin-treated hoods (perm-hoods)

D_1,D_2 Diethyltoluamide-treated hoods (deet-hoods)

C_1,C_2 Untreated hoods

M Mosquito count

B Blackfly count

* Simuluim venustum, S. decorum, Aedes vexans, A. cummunis, Culex restuans.

Table III

Mosquito Accumulations on Faces of Human Subjects with Hoods, Stoney Swamp

Time in minutes	P_1	P_2	D_1	D_2	C_1	Remarks
30	1	0	3	1	58	Species; Aedes vexans, A. sticticus, Mansonia perturbans
60	1	0	4	1	89	

Legend P_1, P_2 Permethrin-treated hoods (perm-hoods)

D_1, D_2 Diethyltoluamide-treated hoods (deet-hoods)

C_1 Untreated hoods

Table IV

Mosquito Accumulations on Chests of Human Subjects Wearing CF Combat Clothing, Pink Lake

Time in minutes	C_1	C_2	C_3	P_1	P_2	P_3	Remarks
30	47	54	74	0	0	1	Species; Aedes vexans, A. communis, A. punctor* Culex restuans
60	67	134	102	0	0	1	

Legend P_1, P_2, P_3 Permethrin-treated uniforms

C_1, C_2, C_3 Untreated uniforms

* Probable

DISCUSSION

The Table I data for the plastic heads charged with dry ice showed that the repellent (deet)-treated open-face hoods continued to give excellent protection to the face from blackflies. These data also indicate that the insecticide (permethrin)-treated hoods provided a level of protection that was intermediate between the deet-treated items and the controls. Table II and III indicated that both the deet-hoods and the perm-hoods gave good mosquito protection to the human subjects.

The dry-ice-charged plastic heads were not considered to be a replacement for human test subjects but were used as a screening technique only. The Table I data for the perm-hoods indicated that they were not nearly as efficacious as the deet-treated items whereas Tables II and III suggested that the deet- and permethrin-treated items worn by human subjects were about equal in protective value. The body heat given off by the human subject wearing a hood may increase the evaporation rate of the chemical treatment, particularly the permethrin, and so increase the latter's effectiveness. This may account in part of the delayed reaction in biting-fly protection of permethrin-treated mesh jackets which was indicated in the 1978 field results (3). The data from the three tables supported the previous findings that the deet- and permethrin-treated items gave protection against at least some species of both mosquitoes and blackflies.

The weather and other factors did not allow as extensive an evaluation of the permethrin-treated CF summer field clothing as had been planned. The limited data in Table IV indicated that the permethrin treated garments gave good body protection to the wearers from mosquitoes. It had also been planned to assess the permethrin field clothing, worn with wither the deet or permethrin open-face hoods, against untreated field clothing with the standard deet jacket and attached hood worn over it but the weather delayed the test. This study will probably be done in 1980 using both full-sized dry-ice-charged display models and human subjects.

To date, the best personnel biting-fly protection has been given by the standard deet-treated jacket with attached open-face hood. For CF personnel in the field who are already overburdened with auxiliary equipment, an acceptable level of mosquito and blackfly protection would probably be provided by a separate open-face deet-treated hood plus either an insect-bite-proof garment or permethrin-treated field clothing. The latter item would not likely need retreatment for the entire biting fly season in Canada and perhaps longer. The duration of effectiveness of the permethrin items needs to be determined.

CONCLUSIONS

1. It was confirmed that the separate deet-treated open face-hoods provided excellent protection to the wearer's face from mosquito and blackfly bites.

2. When worn with insect-bite-proof clothing, these hoods formed a good protective system.

3. Permethrin-treated open-face separate hoods were not as effective as the deet-treated item when tested on dry-ice-changed plastic heads.

4. Additional testing of the permethrin-treated hood is needed using human subjects.

5. The dry-ice-charged plastic heads appeared to be a useful screening technique for candidate hoods or headnets for blackfly protection.

6. The data indicated that combat clothing treated with permethrin insecticide was a promising biting-fly protection technique.

RECOMMENDATIONS

1. Larger-scale field tests against heavy populations of mosquitoes and blackflies, perhaps using CF personnel at Yellowknife, NWT., should be conducted with permethrin-treated combat clothing worn with either diethyltoluamide- or permethrin-treated open face hoods.

2. Full-size manikins charged with dry ice should be assessed for primary testing of experimental clothing systems for biting-fly protection.

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ACKNOWLEDGEMENTS

The assistance of Messrs. D. Pichette, M.M. Dewar and Pte. R. Perron, often given with short notice, was greatly appreciated. Mr. B. Lacroix conducted the treatment of the various test items and was a test subject. Mrs. S. Snedden typed the manuscript and Dr. G.R.L. Brossard assisted with the résumé.

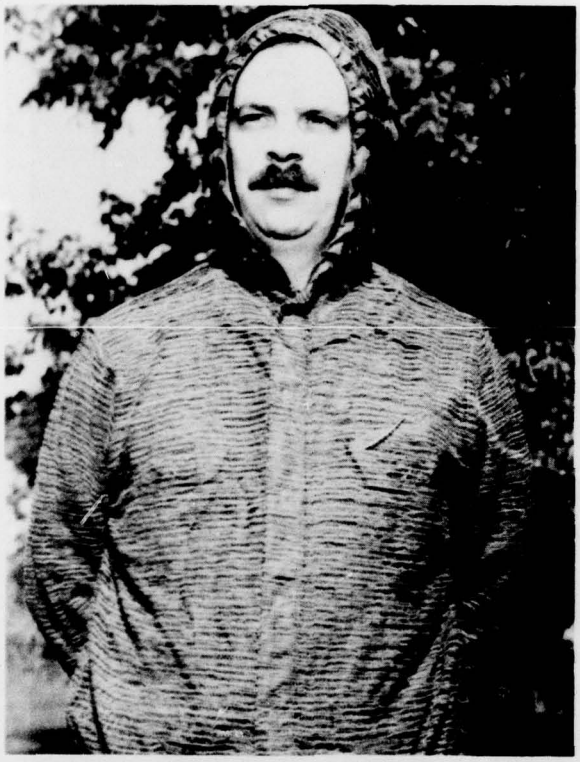

Figure 1. Jacket with attached open face hood.

Figure 2. Separate open face hood.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

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1. ORIGINATING ACTIVITY
Defence Research Establishment Ottawa
National Defence Headquarters
Ottawa, Ontario, Canada K1A 0Z4

2a. DOCUMENT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. DOCUMENT TITLE
Additional Studies of Chemically Treated Clothing for PErsonnel Protection from Biting Flies

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Note

5. AUTHOR(S) (Last name, first name, middle initial)
Lindsay, I.S., Farnworth, B. and Osczevski, R.J.

6. DOCUMENT DATE
November 1979

7a. TOTAL NO. OF PAGES
14

7b. NO. OF REFS
9

8a. PROJECT OR GRANT NO.
14B00

9a. ORIGINATOR'S DOCUMENT NUMBER(S)
DREO Technical Note 79/28

8b. CONTRACT NO.

9b. OTHER DOCUMENT NO.(S) (Any other numbers that may be assigned this document)

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES

12. SPONSORING ACTIVITY

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DSIS
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Insect repellents
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